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Bulletin

Empire State Forest Products Association

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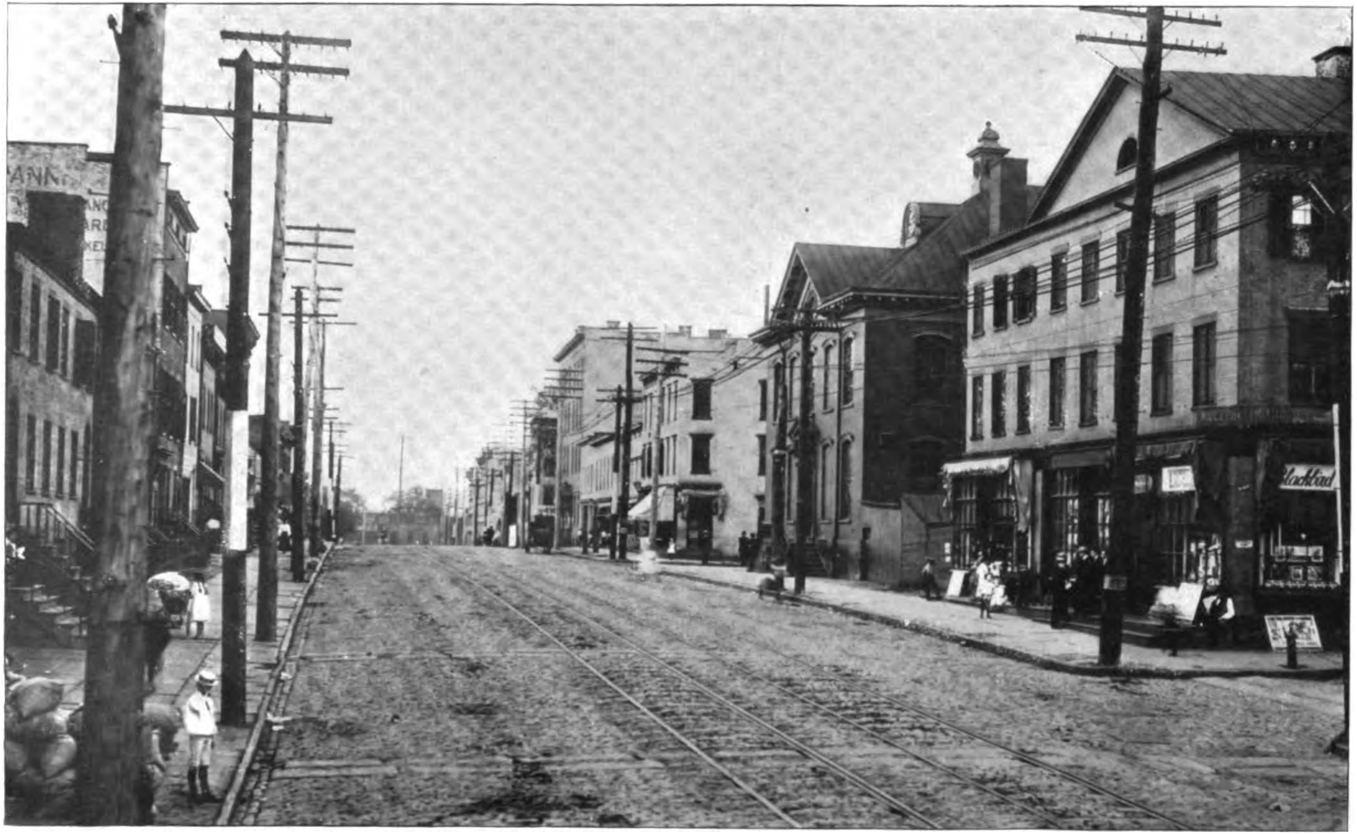

A Treeless Street

Walter Mulford

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BULLETIN 7

SHADE TREES

BY

F. A. GAYLORD

State Forester

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INTRODUCTION.

This bulletin is published with a view to meeting the demand of the public for information concerning shade trees. A department of forestry does not, in its true duties, consider the subject of shade trees. However, there have been so many inquiries coming in to the Conservation Commission concerning this subject, that it has been deemed advisable to publish a pamphlet covering it. Nothing new or original is contained herein. The following pages are merely a compilation of facts from various sources combined with the field knowledge of the writer.

Sargent's "Trees of North America," "Our Native Trees" by Harriet L. Keeler and "Care of the Trees" by Prof. B. E. Fernow, combined with various State bulletins, have been the principal sources of information. To all of these publications the writer is deeply indebted.

An attempt has been made to select the trees which are most commonly met with in planting work in New York State, and only those tree features are taken up which are of importance in considering ornamental and shade values. The matter relating to the planting and the care of the trees has been considered in a brief way in order to make the work as popular and useful as possible.

UNIV. OF CALIFORNIA

DESIRABILITY OF SHADE TREES.

When one visits a city for the first time, that city always makes more or less of an impression for the good or bad, according to many factors. In brief, these factors might be stated as follows: The surrounding country and topography of the city, the architecture of the public buildings, the condition and cleanliness of the streets, the look of prosperity or poverty in the dwelling sections, but above all, the tree and plant growth in and around the settlement.

When one has traveled through the mushroom towns of the plains, the invariable impression is one of desolation and when the impression is analyzed, it is simply because of the lack of tree growth of any kind. The towns in the coal fields of Pennsylvania are unsightly for the same reason. Why is it that Washington, D. C., is considered such a beautiful place? True, it has some of the most interesting buildings in the country, but at the same instant one thinks of the beautiful, wide, shaded streets. The trees of many New England towns have become really noted. New Haven, Conn., has long been known as the City of Elms. Even the elms in the historic town of Old Hadley, Mass., are never forgotten by a visitor.

Trees do a great deal to make a city more habitable. They not only shade the street, making it more congenial to travel by reducing the high temperatures due to reflection on the stone pavements, but they soften the whole tone of the place and make it more restful. They do a great deal to counteract the city influences and make it more like the country. They increase the value of property by inviting settlement, and they make it more healthful by absorbing many of the gases which act as poisons to human beings.

Planting should not end with the crowded sections of the city, but all traveled highways would be more pleasant and beautiful if edged with trees. In all probability the State highways will be planted with trees in the near future and if the counties will also take up this work, the improvement would soon be appreciated. Considering the high cost of building good roads (macadamized roads about $8,000 per mile), the additional cost of planting trees would be very small, considering the improvement.

Tree planting may be done in many ways. The first attempts are usually by the owner of the property himself. Later it may be put into the hands of one of the several nurserymen who are to be found in all cities. The last and the best way is to have a tree commissioner or city forester, who shall plant the trees of a city according to some definite plan. The city of Washington was planted in this way and the contrast of this city to most others is great and very apparent.

Where the town or city does not take up the question of shade trees as a community, those interested could band together and provide for the planting and protection of shade trees. This has been tried out in some cities with very good results and with a great reduction in cost.

To properly carry out any scheme of shade tree planting in the absence of a city forester, each individual has to do his part. He alone must see to it that his property is planted to shade trees. His responsibility does not end here either, as he must care for the trees very carefully, to protect them from deteriorating influences which are only too abundant in the city. A little time and money spent when needed will prolong the life of a tree many years.

PART I.

TREE CHARACTERISTICS.

SELECTION OF TREES.

In selecting a shade tree, the following considerations should be borne in mind: (1) Ornamental value desired, (2) shading value, (3) soil and moisture conditions, (4) rate of growth, (5) size and character of growth, (6) cleanliness of habit, (7) liability to insect and fungus damage, (8) endurance of the hard knocks of the city.

Hardwoods or broad leaved species are used in practically all cases. The white or American elm and the sugar maple are the two most popular species, behind which come about thirty trees, which are valuable for shade and ornamental purposes.

When we are deciding on our street trees, we should be careful to select the species which will grow to a size in keeping with the width of the street. In the following lists, the trees which are to be discussed are arranged according to the width of the streets, to which they are best suited. In each list the trees are grouped as nearly as possible in their relative value as shade trees.

Wide Streets.

Name.	Other Common Names.
Elm.	American or White Elm.
Sugar Maple.	Hard or Rock Maple.
Sycamore.	Buttonwood, Buttonball or Plane Tree.
Beech.	Red Beech.
White Oak.	
Weeping Willow.	
Carolina Poplar.	Cottonwood, Yellow Cottonwood, Cotton Tree.
Black Walnut.	Walnut.
Yellow Birch.	Gray, Swamp or Silver Birch.
Chestnut.	

Intermediate Streets.

Name.	Other Common Names.
Norway Maple.	
Horse Chestnut.	
Tulip.	White Wood, Yellow or Tulip Poplar.
Sweet Gum.	Red Gum, Liquidamber, Satin Walnut.
White Ash.	
Red Oak.	Black Oak.
Cucumber Tree.	Magnolia, Mountain Magnolia.
Basswood.	Linn, Linden, White Wood.
Pin Oak.	Water, Swamp or Swamp Spanish Oak.
Silver Maple.	Soft, White or Swamp Maple.
Honey Locust.	Sweet, Black or Thorny Locust.
Mulberry.	Black Mulberry.
Ailanthus.	Tree of Heaven.
Golden Willow.	White, Yellow or Blue Willow.
Hackberry.	Sugar Berry, Nettle Tree or Hop Ash.
Scarlet Oak.	Red or Black Oak.
Sassafras.	
Kentucky Coffee Tree.	Coffee Nut, Mahogany.
Paper Birch.	Canoe, White or Silver Birch.
Hornbeam.	Ironwood, Leverwood, Hardhack.
Hickories.	
Black Gum.	Sour Gum, Tupelo, Pepperidge.
Butternut.	White Walnut or Buttnut.
Black Birch.	Sweet or Cherry Birch.
Rock and Slippery Elm.	
Chestnut Oak.	Rock or Tanbark Oak.

Narrow Streets.

Name.	Other Common Names.
Lombardy Poplar.	Black Poplar.
Catalpa.	
Red Maple.	Soft, Swamp or White Maple.
Locust.	Black or Yellow Locust.
Box Elder.	Ash Leaved or Cut Leaved Maple.
Cherry.	Black, Wild or Rum Cherry.
Gray Birch.	Old Field, White or Poverty Birch.
Large Toothed Aspen.	Poplar, Popple, White Popple.
Trembling Aspen.	Aspen, Quaking Asp, Popple, Poplar.
Black Oak.	Yellow Oak.

We must not select those tree species which branch low down. We must be careful and not select trees which will bear nuts, fruits or flowers, which would be tempting to the public, and particularly small boys. If such trees are planted in public places, the ground at certain times of the year will be strewn with debris and the tree will suffer more or less injury by branches being broken.

The longer the leaf season, the more valuable is the tree. As a rule, the denser the shade, the more serviceable. Even the bark of the trees bears a close relation to their value as street trees. White birch could never be planted in the streets, as it would be stripped almost immediately. The trunk of the beech tree is usually much mutilated by carving in the smooth bark.

The fall coloring of the tree is another thing that should be taken into account when species are being selected for planting. The coloring of each species is taken up in the individual descriptions of the various trees, but little is said of the time of changing color. Colonel Fox, in a bulletin published some years ago, arranged the common trees in three groups as follows:

The trees with foliage turning earliest are red maple, white elm, sumach, yellow locust, sour gum, horse chestnut, silver maple, yellow birch, hickory, tulip, sassafras, butternut, black walnut, cucumber tree, Kentucky coffee tree.

The intermediate trees, sugar maple, sweet gum, chestnut, red and pin oak, beech, white and black birch, aspen, white ash, hornbeam, blue beech, Carolina poplar, basswood, black ash.

The latest trees to turn, scarlet oak, dogwood, honey locust, lombardy poplar, white oak, black cherry, sycamore, Norway maple, ailanthus, willows, larch and ginkgo.

The trees selected should be healthy, straight, well-rooted specimens and as large as can be conveniently handled.

The following is a list of all common trees which have any bearing on the problems under consideration. Under each species is given its chief characteristics as they affect its value as a shade tree.

BROAD LEAVED SPECIES.

BLACK WALNUT.

Juglans nigra.

(Other common name — walnut.)

This tree is found from Massachusetts and Minnesota south to Texas and Florida. It is most abundant in the region west of the Alleghany mountains.

The bark is dark brown slightly tinged with red, deeply divided into broad round ridges, broken on the surface by thick scales. The tree often reaches a height of 100 feet. Its maximum height is 150 feet. The trunk gets to be 4 to 6 feet in diameter and is often clear of branches for 50 feet when surrounded by other trees. A narrow round top is formed by stout, gradually spreading branches. This head broadens out at maturity and is quite thin.

The growth is rapid on good soil. For its best growth the soil must be deep, porous and moist, in short, a true agricultural soil. On a poor soil the growth is very slow. The tree lives to be 250 years old under the best conditions. It is one of the most light-demanding trees we have. It must have full light from the start. It would, therefore, do poorly if overtopped in group planting. As the tree has a deep, wide-spreading root system it is wind firm.

The wood is usually free from fungus and insect damage, but the foliage is often eaten by insects. In the fall the compound leaves turn yellow and fall early, making a short leaf season. This tree makes a very impressive appearance because of its massive form. It is rather difficult to transplant.

There are, therefore, several objections to planting this tree; it is hard to transplant, it requires a rich soil, it is quite intolerant, the leaf period is short, its leaves are much eaten by insects and the character of the fruit would lead to harsh treatment by man. On the other hand, it grows fast and is a magnificent tree for decorative purposes, while the fruit is most delightful.

This tree would hardly do in a crowded community, but in the country it would prove satisfactory.

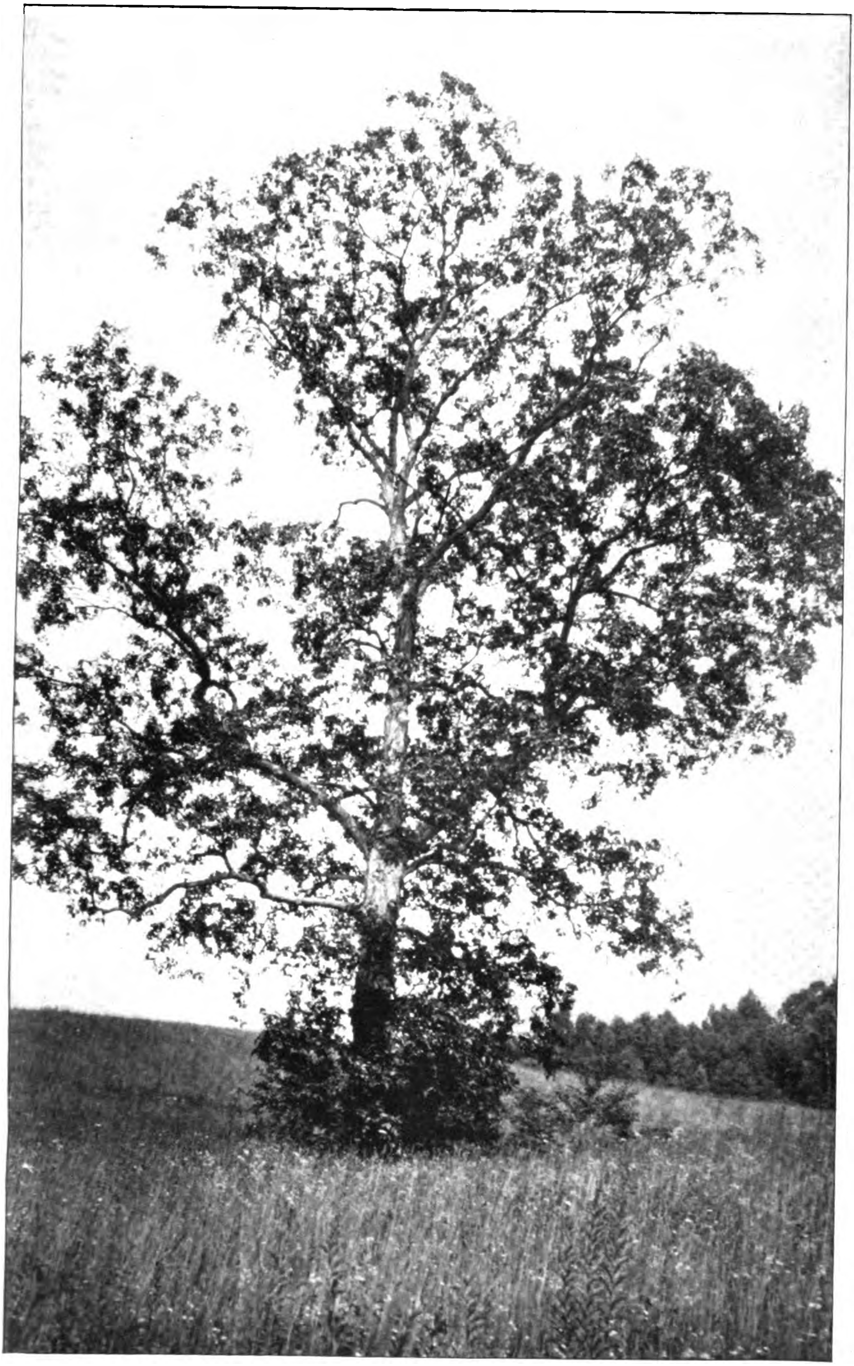
BUTTERNUT.

Juglans cinerea.

(Other common names — white walnut and buttnut.)

This tree is found from New Brunswick and Dakota to Georgia.

The bark is light brown, deeply divided into broad ridges, which separate on the surface into small scales. It sometimes reaches a height of 100 feet and a diameter of 2 to 3 feet. The trunk usually divides 20 or 30 feet from the ground into many stout limbs spreading horizontally and forming a broad, low symmetrical round-topped head. The crown is very thin after the pole stage. The root system is quite deep.



Shagbark hickory

The growth is very rapid, especially in the younger stages, but the tree is short lived, seventy-five years being about the limit. It will grow in much poorer soils than the black walnut and will stand much more moisture, it sometimes being found in fresh swamps. The tree is very light demanding, and it is necessary to give it full light from the start. The leaves turn yellow in the fall. It is wind firm because of its large, deep root system, but it is often broken by the wind. The foliage is badly injured by insects.

The drawbacks to this tree are very similar to those for black walnut, namely, intolerance of shade, defoliation by insects, breaking of the branches by fruit stealers, difficulties of transplanting and a short leaf period; while on the other hand, its requirements in regard to soil and moisture are not as exacting as with the walnut, but the tree is much shorter lived and not as beautiful. If it is desired to plant a rocky situation, where there is shallow but rich soil, this tree would be better than black walnut, otherwise walnut should be planted. Neither should be planted, however, if small boys infest the neighborhood.

SHAG BARK HICKORY.

Hicoria ovata.

(Other common names — shell bark hickory, scaly bark hickory, walnut, sweet walnut and white hickory.)

The shag bark hickory is distributed from Maine and Minnesota south along the Appalachian mountains to northern Florida.

The bark is light gray and on the mature tree separates into thick strips, often a foot or more in length and 6 or 8 inches wide. The tree usually is not over 90 feet high and 3 to 4 feet in diameter. The trunk divides 10 or 15 feet from the ground into stout, slightly spreading limbs, forming a narrow, inversely conical, round-topped head of more or less pendulous branches.

The tree is largely confined to rocky and sandy soils. It is seldom found on heavy clay soil. The growth is slow. The tree lives to be 150 to 200 years old. The foliage is very thin and turns a clear yellow in the fall. More than fifty species of insects are known to feed on its leaves. Boring insects also do much damage to the wood. The tree is very wind firm.

The hickory grows on very poor soil and this is much in its favor. As a shade tree, however, it is of little value, as it casts but little shade. It is light demanding, the wood and leaves are badly attacked by insects and the fruit is a great attraction to children.

MOCKERNUT.

Hicoria alba.

(Other common names — whiteheart hickory, bull nut, hard barked hickory.)

The characteristics of this tree are very much the same as those of the shagbark hickory.

TREMBLING ASPEN.

Populus tremuloides.

(Other common names — aspen, quaking asp, poplar, popple.)

This tree is found practically all over the United States where there is tree growth.

The bark is pale yellow brown, orange green or nearly white. On old trees it is nearly black and deeply divided into flat ridges. It reaches a height of 100 feet under favorable circumstances and a diameter of 3 feet, although it is usually not more than 18 inches in diameter. Slender, remote and often contorted branches, somewhat pendulous toward the end, form a narrow, symmetrical, round topped head, through which a straight trunk extends.

It is of fast growth but short lived. It reaches its best development on a fresh gravelly or sandy soil, although it will grow on any soil. It is much troubled by fungus growth. It is the most light demanding or intolerant tree of all hard woods. A very noticeable feature of this tree is the leaf movement, which gives the tree the appearance of trembling. The leaves turn a clear yellow in the fall. The tree is easily transplanted. It is very liable to sucker. The shade cast is very light.

This is a very poor tree for street planting.

LARGETOOTHED ASPEN.

Populus grandidentata.

(Other common names — poplar, popple, white poplar.)

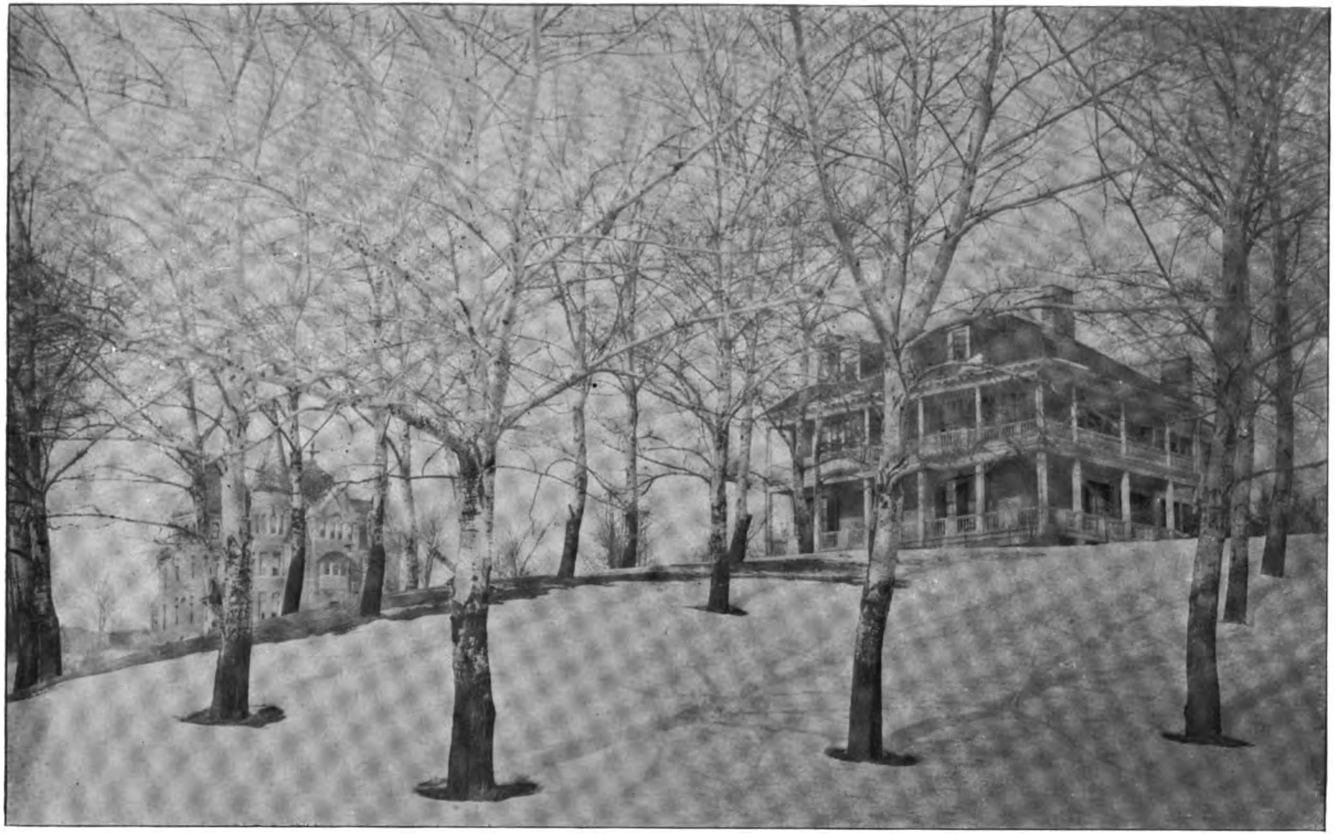
The characteristics of this tree are practically the same as those of the trembling aspen.

CAROLINA POPLAR.

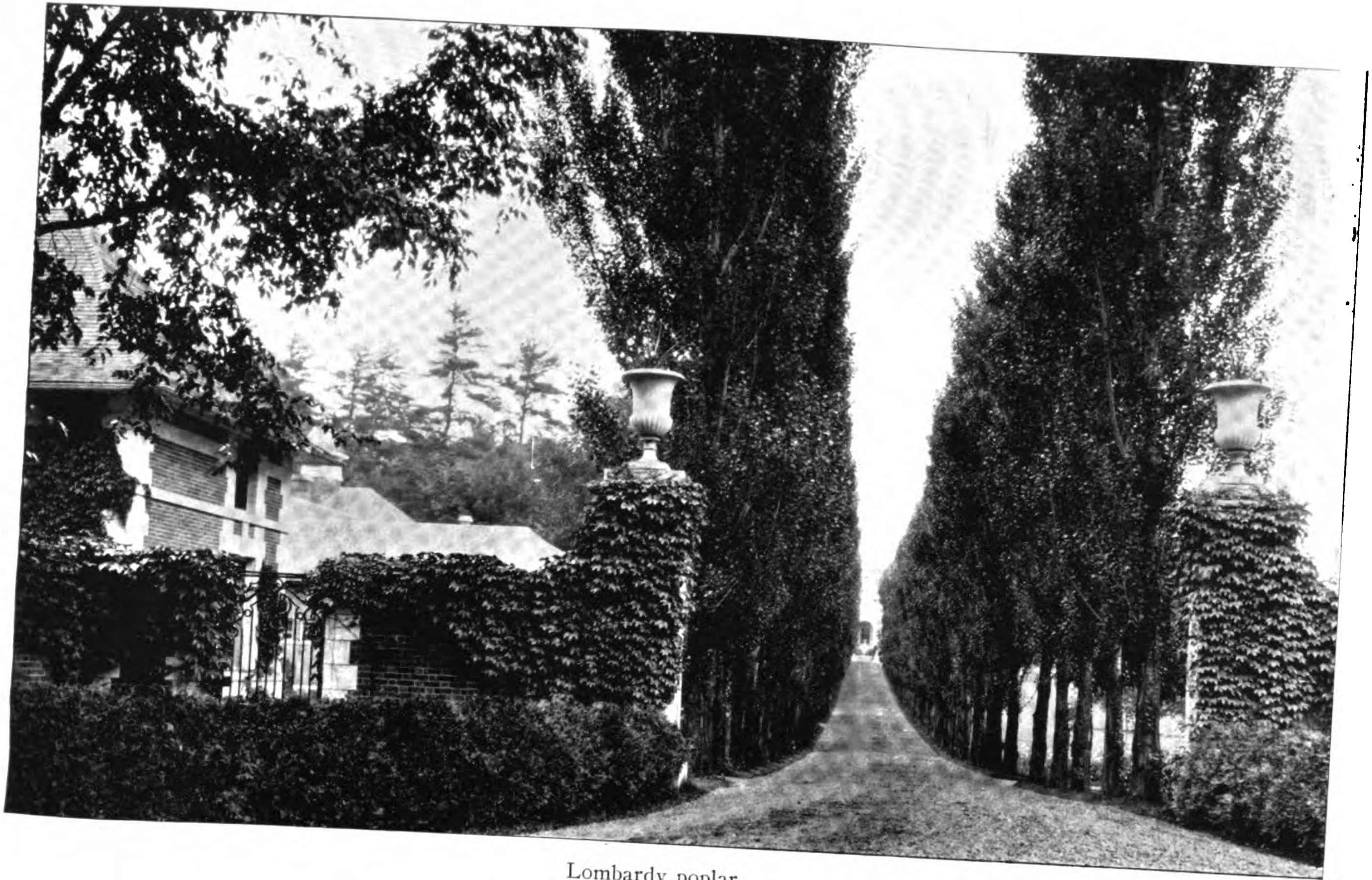
Populus deltoides.

(Other common names — cottonwood, yellow cottonwood, cotton tree.)

This tree is found east of the Rockies, from Canada to Florida and New Mexico.



Trembling Aspen



Lombardy poplar

The bark is thin, smooth and light yellow, tinged with green, becoming on old trees ashy gray and deeply divided into broad rounded ridges. It occasionally grows to be 100 feet high and 7 or 8 feet in diameter. Twenty to thirty feet above the ground it divides into several massive limbs, spreading gradually and becoming pendulous toward the ends, forming a graceful, rather open head, sometimes 100 feet across. In young trees the head is more symmetrical and pyramidal. The root system is wide spreading and shallow. It reproduces abundantly by root suckers. It sprouts well on young timber.

The growth is very rapid, but the rate depends largely on the soil moisture. The tree does not live much longer than seventy-five years. It is very light demanding and intolerant. It is not exacting as to soil, moisture being the chief consideration. It is much subject to heart rot and wind break. Trees are usually grown from cuttings.

Of the native species of popple this is the most desirable, as it is the most ornamental. Its foliage is large and glossy and turns a clear yellow in the fall. It has the longest leaf period. It stands much smoke and abuse. It is easily transplanted. The wind distributes the seeds by means of a cottony tuft, which is quite disagreeable and in many towns ordinances have been passed against the use of this tree. Its rootlets are so intense on their quest for moisture that they have been known to clog the sewers in the city streets.

Owing to its short life this tree is not recommended except in temporary planting, where shade is desired quickly. Better trees may be planted with the poplar in view to cutting out the popple when the second species are large enough. The wind breakage from which this tree so often suffers can be greatly alleviated by judicious pruning.

LOMBARDY POPLAR.

Populus lombardiana.

(Other common name — black poplar.)

This was the first ornamental tree introduced into this country from Europe. It is the only deciduous tree whose branches hug the stem, giving it a spire-like form that can never be mistaken. It is of very fast growth but short lived and the greatest drawback to the use of this tree is the partial and irregular death of the branches, often within a few years after planting. It casts but very little shade. It does not usually grow over 50 or 60 feet tall and 1 foot in diameter.

It could never be planted on the wide streets. Its greatest use is for ornamental work on lawns.

GOLDEN WILLOW.

Salix alba, var. vitellina.

(Other common names — white willow, yellow willow and blue willow.)

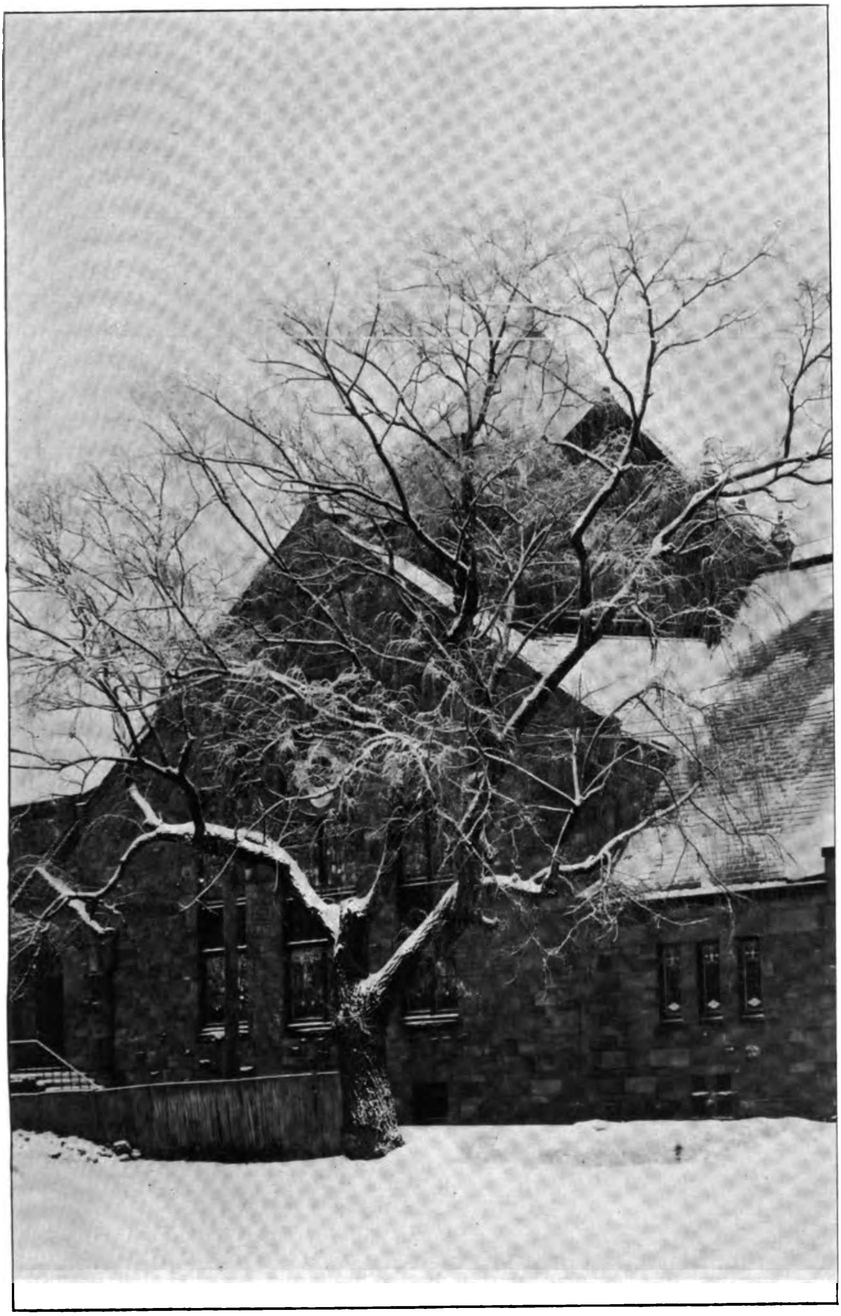
This tree was naturalized from Europe. Practically all willows under cultivation in this country are descendants of the white willow of Europe. The name of this tree comes from the color of its branchlets. It makes a handsome round-headed tree of pretty fair size. The appearance is rather stiff. The leaves are silvery white beneath and give a beautiful contrast with darker leaved species. The willows are extremely hardy but rather intolerant. They reproduce from cuttings. The roots are remarkably tough, large and tenacious. They grow extremely well on the banks of ponds and streams or wherever moisture is present. The tree is subject to sun scald and if pruning is to be done care must be taken not to unduly expose the trunk.

This species is not above the average for street planting, but it cannot be surpassed for planting along river banks, etc. On lawns, in connection with conifers, the contrast of the golden twigs against the dark green would be quite beautiful.

WEEPING WILLOW.

Salix babylonica.

This tree was naturalized from Asia. It is a tree of very striking appearance, as the long, fine branchlets hang vertically downward and give it a very beautiful character. It grows to be a large tree, reaching five feet in diameter. It is a very rapid grower on any soil but a wet one. It suckers very easily. It is rather intolerant and there are quite a few insects that feed on this tree. It is an admirable tree for lawn planting because of its graceful growth habits and the great contrast between it and any other tree.



White willow

HORNBEAM.

Ostrya virginiana.

(Other common names — hop hornbeam, ironwood, leverwood, hardhack.)

This tree is found throughout the hardwood forest area of eastern United States.

The bark is broken into thick, narrow, oblong, plate-like, light brown scales. It occasionally reaches 50 or 60 feet in height and 2 feet in diameter. The branches are long and slender and droop at the ends, forming a round-topped open head often 50 feet across. The growth is slow. It is very shade enduring or tolerant. The leaf is very much like the leaf of the birch and turns a clear yellow in the fall. The green pendulous fruit adds to the ornamental value.

There is exceedingly little to recommend this tree as a desirable shade tree.

BLUE BEECH.

Carpinus Caroliniana.

(Other common names — water beech, hornbeam, ironwood.)

This tree is found throughout the eastern forest area. The bark is smooth and light gray brown, much resembling the bark of the beech. It is rarely 40 feet high and 2 feet in diameter. The trunk is muscled or fluted and more or less irregular. The branches are spreading and pendulous. Sometimes a broad, flat-topped head is formed, sometimes only a shapeless mass.

It grows very slowly. It appreciates moisture but will grow on very poor soils, the better the soil, of course, the faster the growth. In autumn the leaves are bright red, deep scarlet or orange. The tree is very tolerant or shade enduring and stands pruning well. It would make a good tree for shrubbery and group planting only.

PAPER BIRCH.

Betula paperifera.

(Other common names — canoe birch, white birch and silver birch.)

This tree is found from New England to Montana along the Canadian border. The bark is creamy white, lustrous and separates into thin papery layers. It grows to be 70 feet tall and 3 feet in diameter. In youth it forms a compact pyramidal head, which develops into a round-topped open head of pendulous branches, supported on a branchless trunk. It prefers rich, moist hill sides or borders of streams or lakes. In autumn the leaves turn a pale yellow. The value of this tree lies in the beauty of its bark. A tree of this species is always mutilated if in a public place by peeling off the bark and it should only be planted in yards or on estates. It is unsurpassed for group planting where contrast is desired.

YELLOW BIRCH.

Betula lutea.

(Other common names — gray birch, swamp birch, silver birch.)

This tree is found in northeastern United States as far south as Tennessee and North Carolina.

The bark on young trees is a silver gray or orange color, very lustrous, separating into loose persistent scales, more or less rolled on the margins, giving it a shaggy look. In old trees it is divided into large, thin plates by narrow irregular fissures. The tree gets to be 100 feet high and 3 or 4 feet in diameter. The branches are more or less pendulous, forming a broad round-topped head. The root system is very shallow.

The growth is rapid. It lives to be a hundred to a hundred and twenty-five years old. It requires a moist soil and does better on heavy rather than light soils. It is fairly tolerant or shade enduring. The leaves turn a clear yellow in the fall.

When planted in the open it is very liable to branch low down. To get its full beauty it should be planted in large, open places. It is not adapted to street planting.

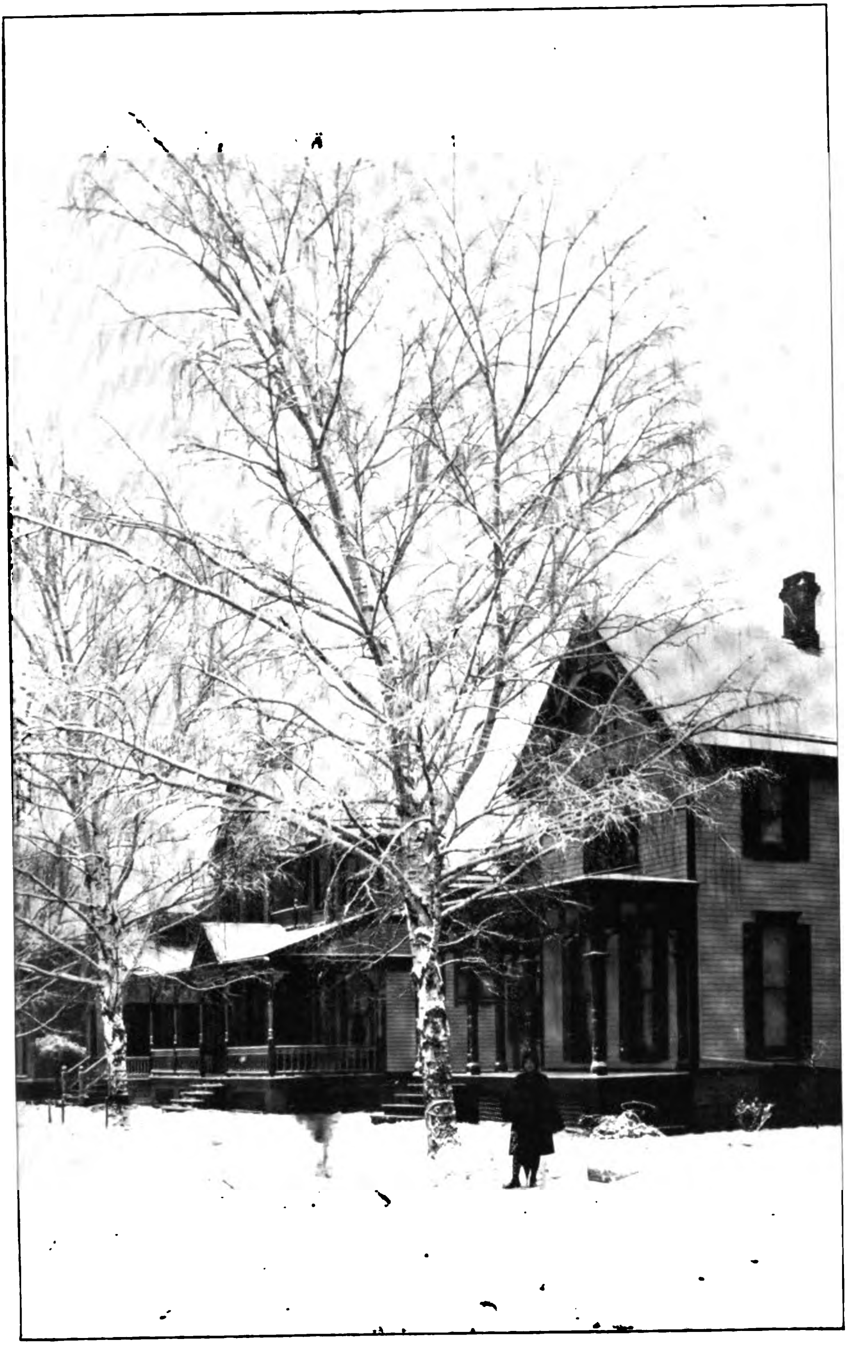
GRAY BIRCH.

Betula populifolia.

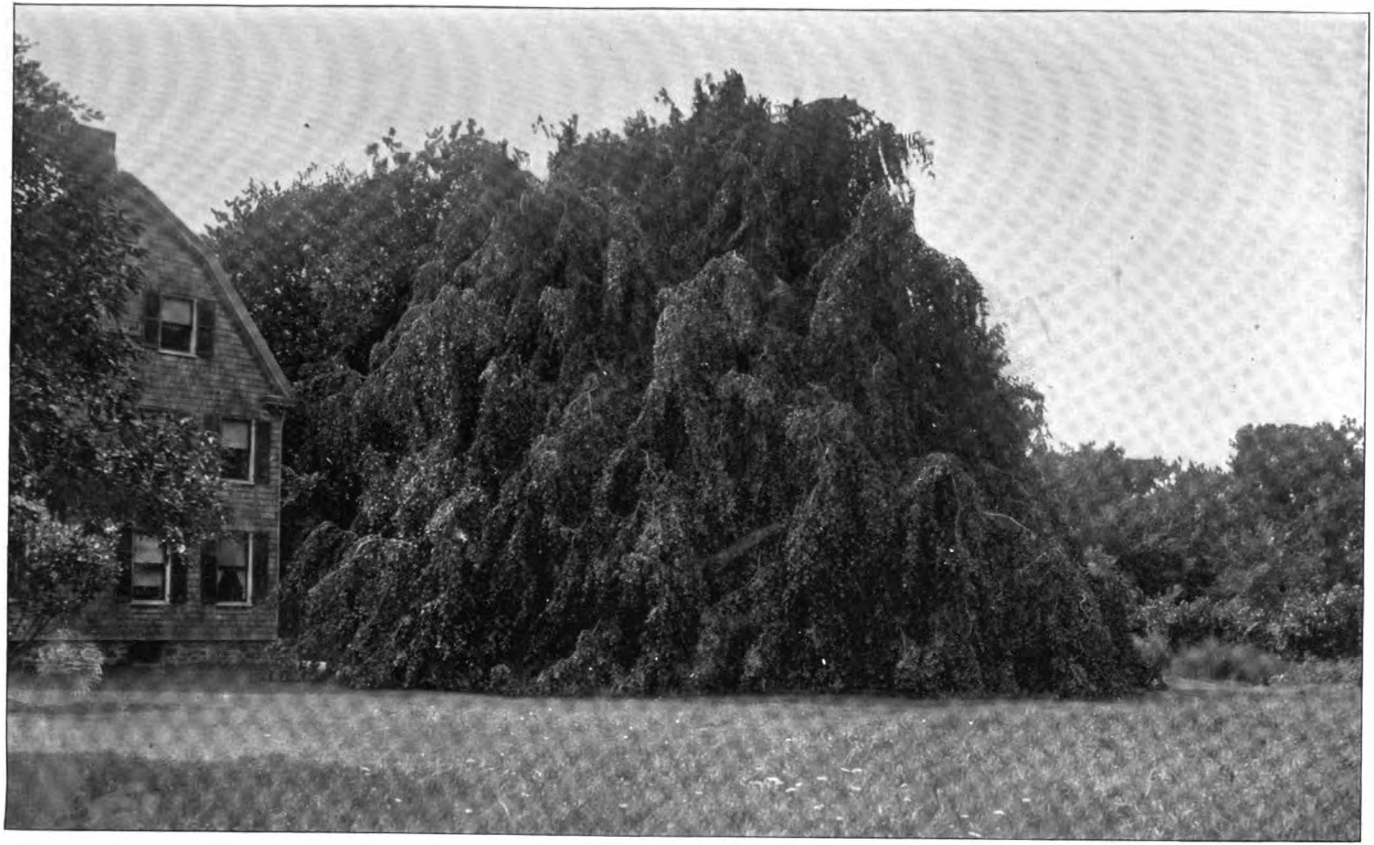
(Other common names — old field birch, white birch and poverty birch.)

This tree is found in New England and New York. The bark is a dull chalky white with dark triangular marking at the insertion of the branches. It sometimes grows to be 40 feet high and 18 inches in diameter. The stem reaches to the top of the crown. Short, slender and pendulous branches form a narrow pyramidal head which reaches nearly to the ground.

The tree grows naturally on dry, gravelly, barren margins of swamps or ponds. It is short lived and grows rapidly. The leaves are tremulous and turn a pale yellow in the fall. It would



White birch



Weeping beech

never do for street planting and should only be used to plant up dry waste areas where few other trees would grow.

BLACK BIRCH.

Betula lenta.

(Other common names — sweet birch and cherry birch.)

This tree is found from New Foundland and Illinois south along the Alleghany mountains to Florida.

The bark on the young stems is smooth, lustrous and dark brown. On older trees it is furrowed and broken into large irregular plates. The bark on the mature trees resembles that of the cherry tree, whence its name, cherry birch. The bark is aromatic with a strong wintergreen taste. It grows to be 80 feet high and 5 feet in diameter. The slender branches finally become pendulous and form a round-topped, open, graceful head. The root system is deep and spreading.

The growth is rapid on rich, deep soils, though the tree will grow on almost any soil. Trees 300 to 400 years of age have been found. It is quite a shade enduring tree, standing next to beech and maple. In the fall the leaves turn yellow. The birches are all easily transplanted from a mechanical side, but the roots are tender and care should be taken that they do not dry out. This tree should be used only in group planting in yards or open places.

BEECH.

Fagus americana.

(Other common name — red beech.)

This is one of the most widely distributed trees in eastern North America.

The bark is smooth and steel gray in color. It is usually 70 or 80 feet high and gets to be 3 or 4 feet in diameter. The limbs are numerous and spread gradually to form a broad compact round-topped head of slightly drooping branches, giving the tree a very characteristic appearance. The root system is spreading and shallow.

The growth is fairly rapid if the tree is not crowded. It seldom grows on dry, light, sandy soil, but does very well on a lime soil. Moisture is the important consideration in the growth of beech. It lives to be 300 to 400 years old. It is one of the most shade enduring trees in our forests and makes a very dense shade. It is particularly subject to heart rot. The tree is very subject to sun scald when suddenly exposed. It has few insect troubles. It is rather hard to handle in transplanting. It propagates freely by suckers.

In autumn the leaves turn a golden yellow. It makes an excellent tree for grouping with evergreens or for any ornamental purpose, as it will persist anywhere if the soil moisture is sufficient and its remarkable beauty, in both summer and winter, makes it very desirable.

A variety of the European beech (Fagus sylvatica, var. pupurea), the purple beech, is used much for ornamental planting, owing to its peculiar copper colored foliage.

CHESTNUT.

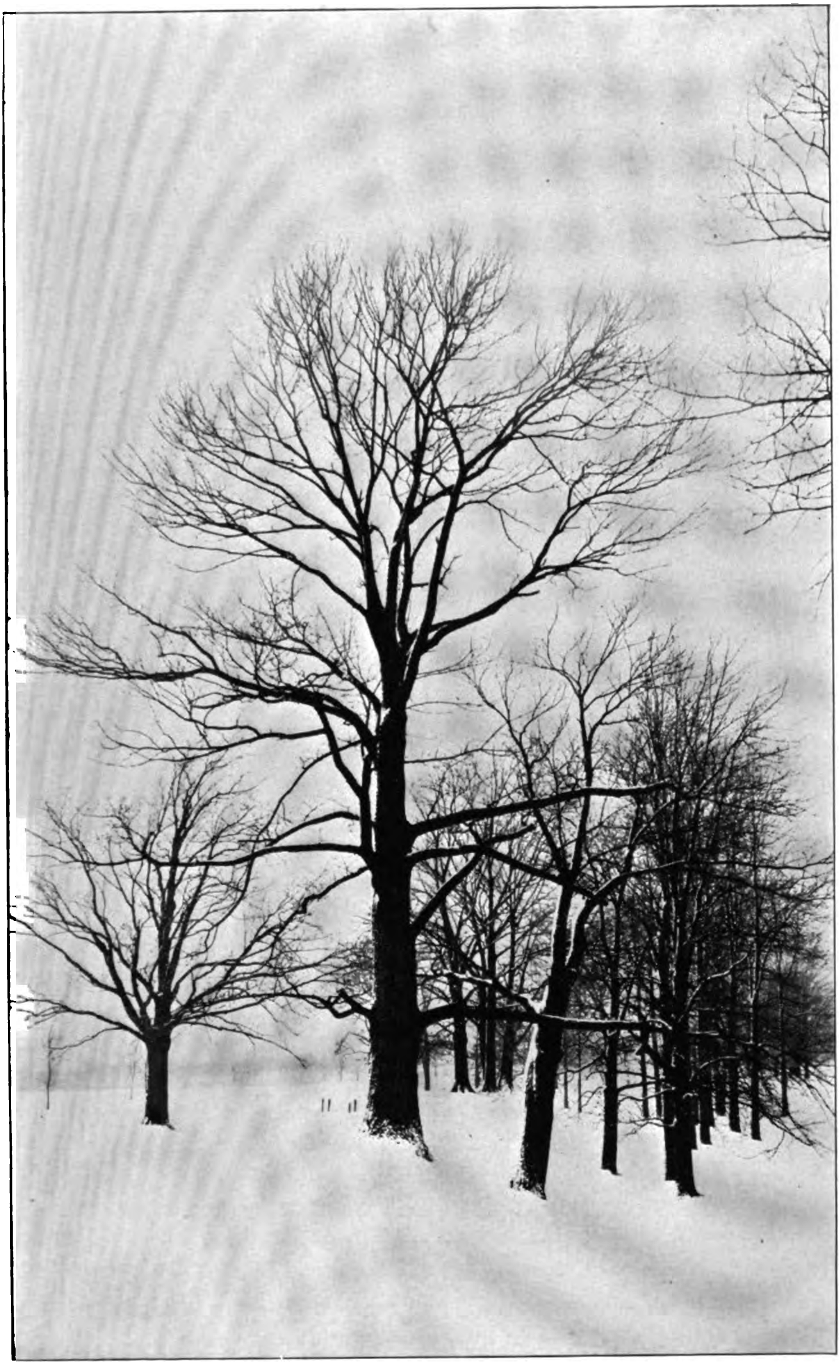
Castanea dentata.

This tree is found from New England to Michigan and south along the Alleghany mountains to North Carolina.

The bark is dark brown and divided by shallow, irregular fissures into broad, flat ridges. It grows as high as 100 feet and usually 3 to 4 feet in diameter, although a diameter of 10 to 12 feet is sometimes found in open grown trees. The trunk usually divides not far from the ground into three or four stout limbs, forming a broad, low, round-topped head, frequently 100 feet across. The root system is deeply penetrating.

It is one of the most rapidly growing hardwood species and lives to a great age. The chestnut is not exacting as to soil conditions, but does best on deep, well-drained, loamy or sandy situations. Chestnut succeeds well on soils too dry for beech and maple. It is very light demanding. It is wind firm but liable to be hollow butted and after maturity it often becomes stag headed. It is very much damaged by insects and fungi. The tree is liable to sun scald and surrounding trees must be cut out with care. It is hard to transplant. It sprouts easily. It cannot well be planted on highways where the travel is heavy, as the desire for the fruit makes much litter and deforms the tree. The leaves turn yellow in the fall.

This tree, although excellent for some reasons, should not be planted at the present time owing to a very infectious fungus that is killing all the chestnut in this part of the country.



Chestnut

WHITE OAK.

Quercus alba.

This tree is found in most of the hardwood forests of eastern United States.

The bark is light gray or nearly white and divided into broad, flat ridges. It grows to be 80 or 100 feet tall and 3 to 4 feet in diameter. It has a broad, round-topped head made up of stout limbs, spreading irregularly and small ridged branches. The root system is deep. The crown is not very dense. The trunk is usually marked by many protuberances.

The tree is rather slow growing but is one of the longest lived trees we have. It prefers a deep, porous, well-drained soil and one that is fairly moist. It will grow on dry rocky or sandy soils but the growth is very inferior. It is comparatively intolerant of shade. Young trees sprout fairly well.

There are many insects which damage this tree and fungous diseases are also more or less frequent, but the damage done by these enemies is usually very small. The gypsy moth, however, prefers the leaves of the white oak above those of any other species and where this insect is abundant the growth of white oak is almost impossible. The leaves turn a deep red in the fall and persist on the tree far into the winter, giving the tree a very beautiful appearance.

In the past this tree has been used very little for planting, probably because of its slow growth. This, however, is largely compensated for by the long life and the hardiness of the species. There is practically nothing that seriously affects this tree except the gypsy and brown tail moths. Great care should be used if planting is to be done where these insects appear. It is fairly easy to handle in transplanting if the tree is not too old.

CHESTNUT OAK.

Quercus prinus.

(Other common names — rock oak, tanbark oak.)

This tree is found from Maine to Indiana, south along the Appalachian mountains to Alabama. It grows to be 60 to 70 feet high and 3 to 4 feet in diameter. It divides about 15 or 20 feet above the ground into large limbs which spread into a broad open irregular head.

The tree is medium as to growth. It requires much less moisture and depth of soil than the other oaks and is especially adapted to rocky situations. It is particularly adapted to poor soil and is to be planted in such situations in preference to white oak. On good soils, white oak should always be favored. It is fairly tolerant of shade. The leaves turn a dull yellow or brown in the fall.

RED OAK.

Quercus rubra.

(Other common name — black oak.)

This oak reaches the farthest north of all oaks and it extends as far south as Georgia and Tennessee.

The bark is dark brown, tinged with red, and divided into thick appressed scales. The tree is usually from 70 to 80 feet tall and 3 to 4 feet in diameter. It has the straightest trunk of all oaks. Its branches are stout and spread gradually to form a comparatively narrow round-topped head or spread at right angles to form a much broader crown. The shade is dense. The root system is not as deep as that of the white oak.

The growth is quite rapid. The tree avoids heavy clays and poorly drained soil. It does better where there is much humidity. It is fairly tolerant. Young trees coppice well. The timber is more or less injured by insects and heart rot. Leaves turn red in the fall.

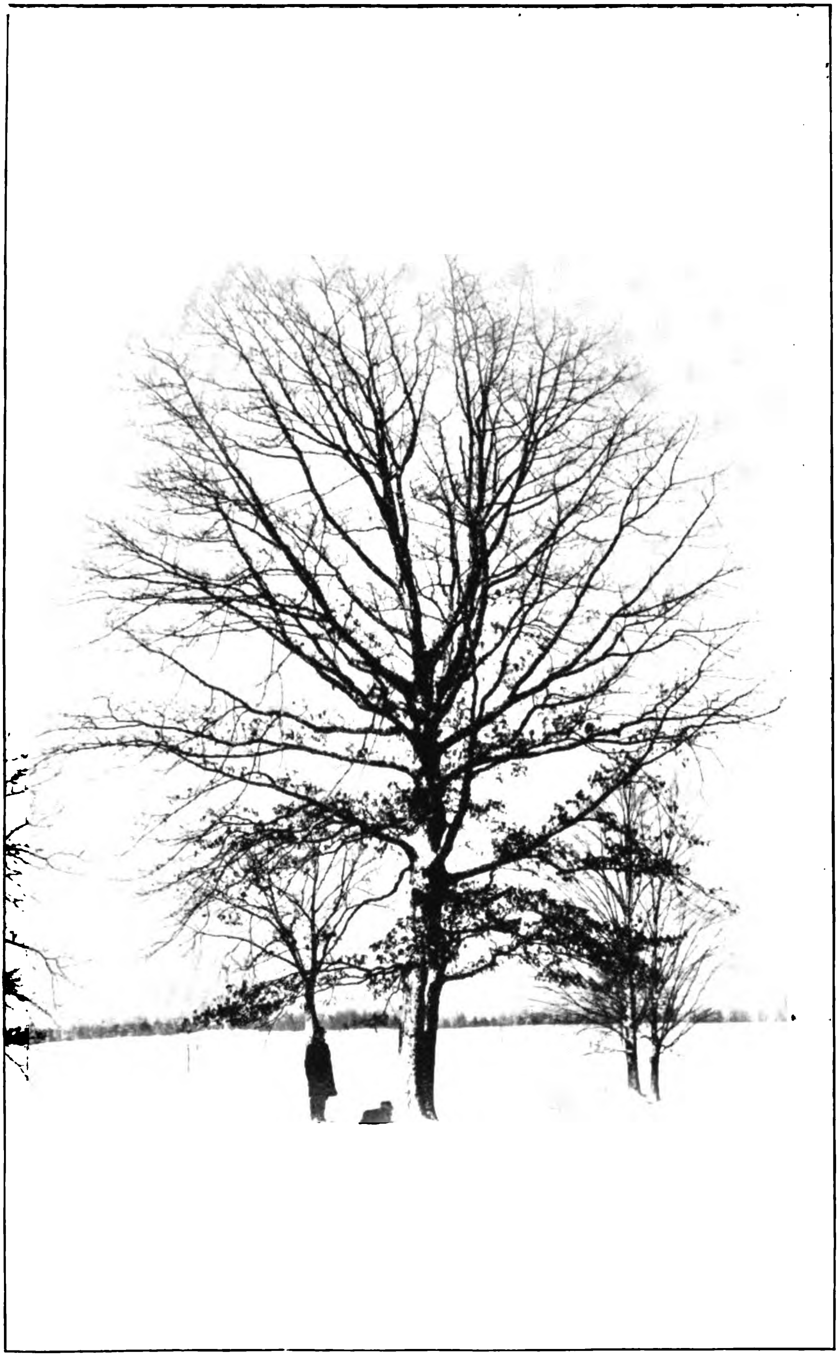
This is the most formal looking tree of the oak group and also of the most rapid growth and densest shade. It is the most easily handled in transplanting of all the oaks. It has much to commend it as a shade tree.

SCARLET OAK.

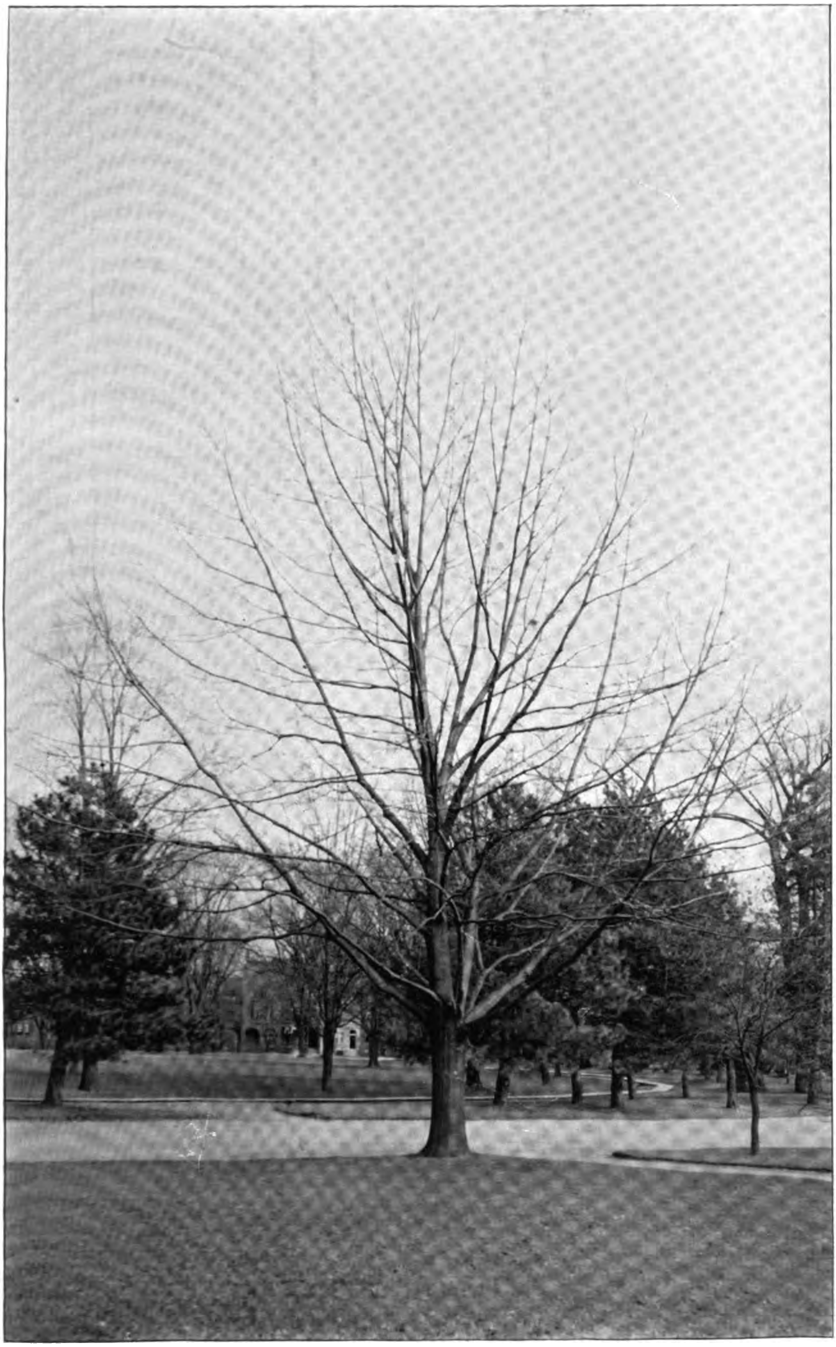
Quercus coccinea.

(Other common names — red oak and black oak.)

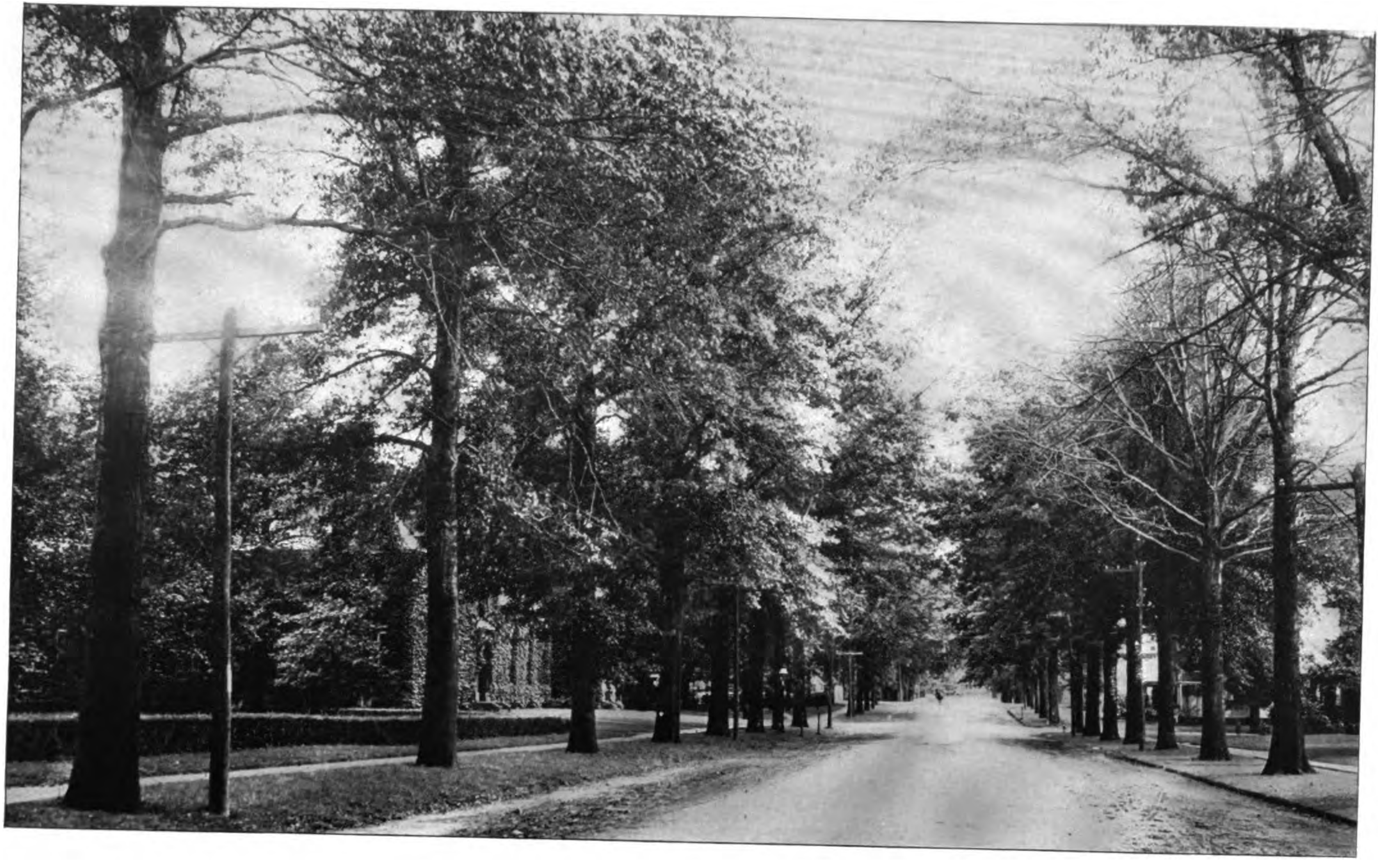
This species is much like the red oak except that its growth habits are not quite as regular. It grows on a poorer soil. Its foliage turns a brilliant scarlet in the autumn and the leaves persist on the tree oftentimes until snowfall.



White oak



Red oak



Pin oaks

BLACK OAK.

Quercus velutina.

(Other common name — yellow oak.)

This species is also much like the red oak but inferior in every way. It will grow on a much poorer soil. Its form is quite irregular and its growth is much slower. It is very intolerant of shade and is about the poorest of the tree oaks. In the fall the leaves usually turn brown.

PIN OAK.

Quercus palustris.

(Other common names — swamp Spanish oak, water oak, swamp oak.)

This is a tree usually 70 to 80 feet tall and 2 to 3 feet in diameter. In youth it forms a broad symmetrical pyramidal head. In old age this crown opens up and becomes quite irregular with rigid and pendulous branches. The form of the tree and the branching is quite a distinctive feature of the pin oak.

This tree likes a moist rich soil, and if wet soils are to be planted, this tree would perhaps be better than the red oak. Otherwise the red oak is superior. In fall the leaves turn a deep scarlet.

AMERICAN ELM.

Ulmus americana.

(Other common names — white elm, elm.)

This tree is without doubt the most popular shade tree in northeastern United States. Of late, however, it has lost much of its popularity because of its numerous enemies. Naturally, it is found scattered over the hardwood forests of the east.

The bark is dark gray and rough and in adherent ridges. It grows to be 100 to 120 feet tall and 6 to 11 feet in diameter. The base of the tree is often much buttressed. It usually divides about 30 or 40 feet from the ground into several upright limbs, which spread gradually and form an inversely conical round-topped head of long graceful branches and drooping branchlets. The form of the tree varies, the most common being what might be termed vase shaped and for grace and beauty, it cannot be excelled. The head is often 100 feet across. The root system is spreading and shallow.

The growth is rapid and 125 years is about the maximum age. It grows best on deep moist fertile bottom land. It does very well on fine silt or clay lands, but does not do nearly as well on sandy soil. It will grow, however, on any kind of soil. The tree is rather intolerant of shade. It is open to the severe attacks of many insects. It is usually hollow butted at maturity and is liable to be wind thrown because of the shallow root system or wind broken, because of the butt decay. It can be handled in nurseries very easily.

The elm is one of the first trees to leaf out in the spring. In the fall, the leaves turn a brown or golden yellow. In order to get the best results, the elm must be given plenty of room. The greatest drawbacks to the use of this tree are the insect and fungous troubles. There is little to be done for the fungous attacks, but the insect trouble can be successfully coped with if the owner is willing to spend a nominal sum each year for spraying. Elms should be planted only on the widest of streets.

ROCK ELM.

Ulmus racemosa.

(Other common names — cork elm, Thomas elm, corkbark elm.)

This elm is very different from the American elm as it has one main axis running up through the crown. It gets to be 100 feet high and 3½ feet in diameter. It has a deep, wide spreading root system. It looks something like an oak. The growth is slow. It is intolerant of shade. It will grow on a much poorer soil than the American elm but aside from this, the latter is decidedly superior. It can be easily distinguished from other trees by the corky ridges on the sides of the branches.

SLIPPERY ELM.

Ulmus pubescens.

(Other common name — red elm.)

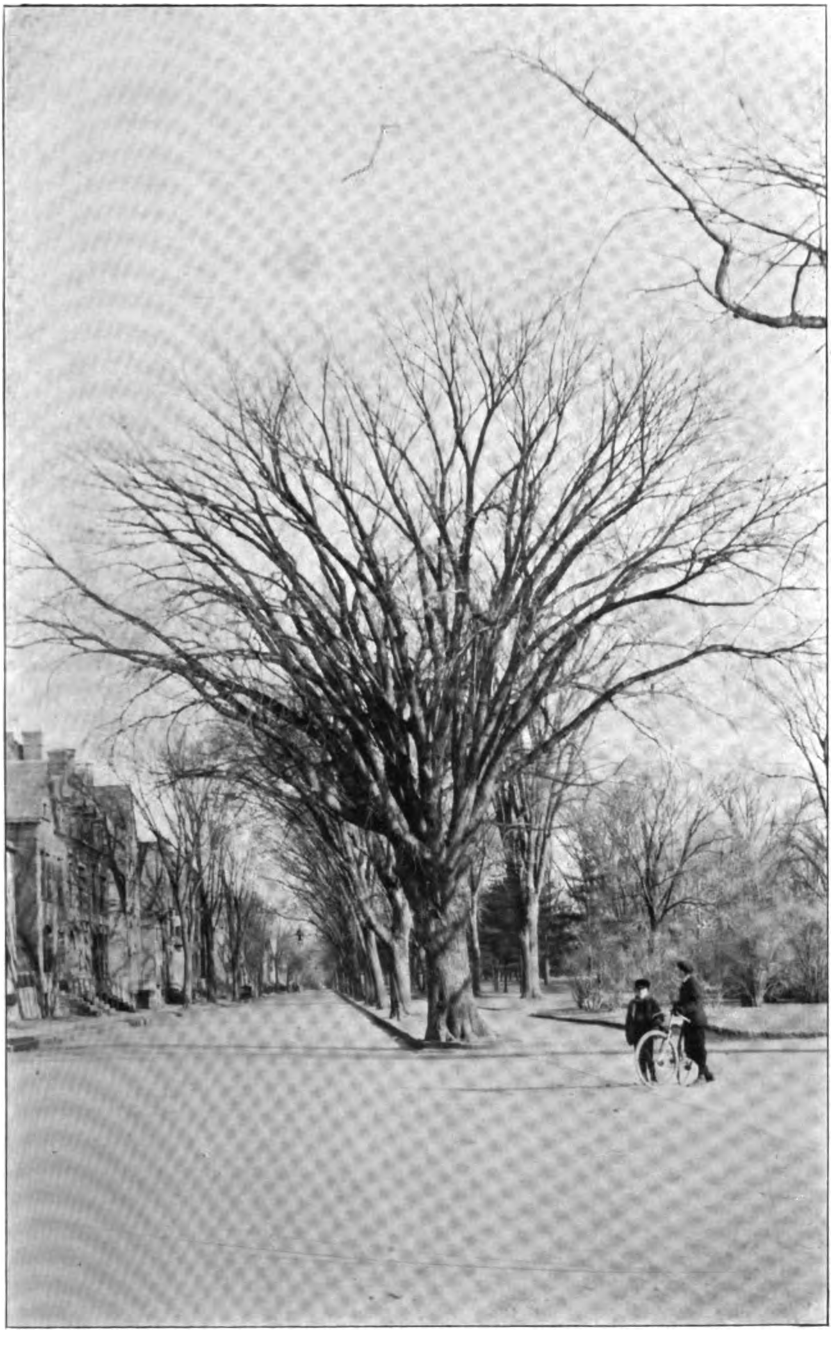
This is a much smaller tree than either of the other two elms considered. The leaf is larger than that of the American elm and turns a dull yellow in the fall. It takes a good soil for successful growth. This species is inferior in every way to the American elm.

HACKBERRY.

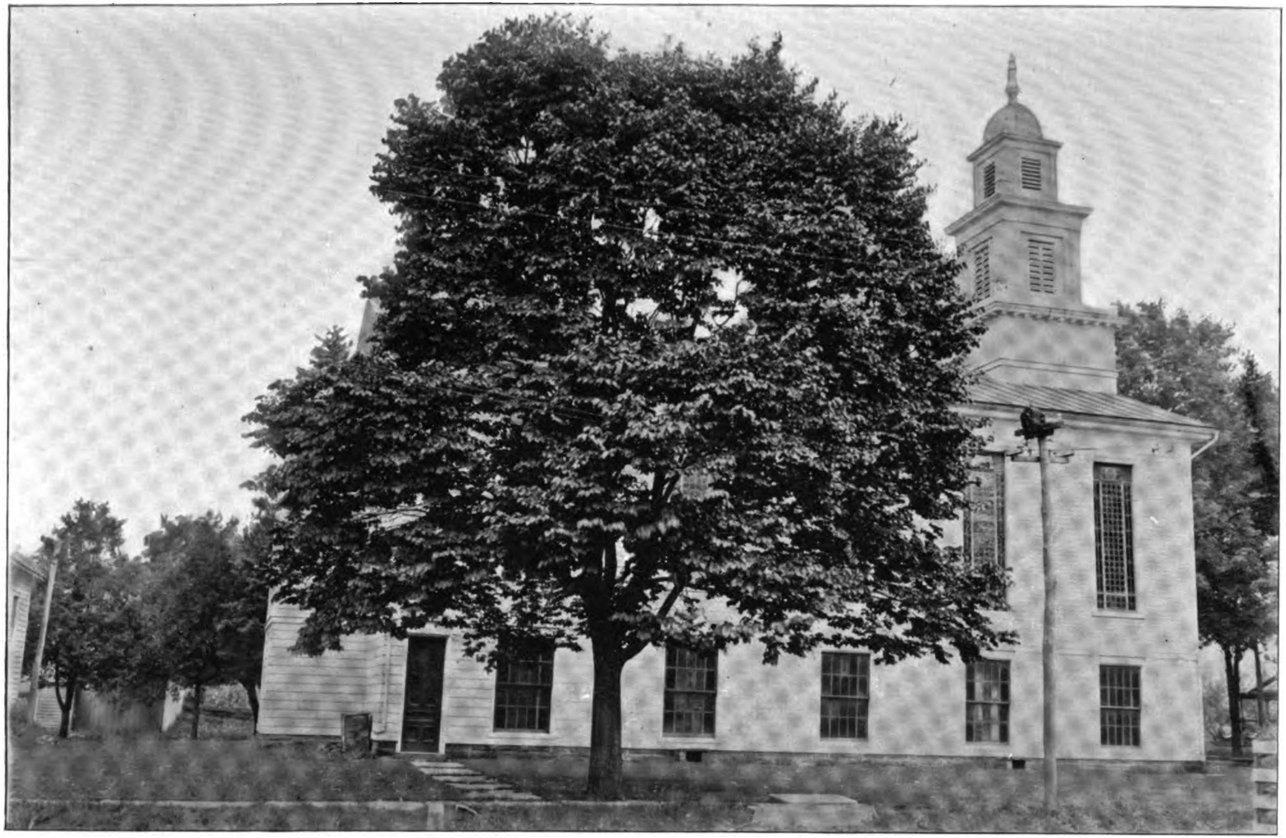
Celtis occidentalis.

(Other common names — sugar berry, nettle tree, hop ash.)

This tree is found scattered over the hardwood forest area of Eastern United States.



American elm



Slippery elm

The bark is light brown, broken on the surface into thick appressed scales and sometimes roughened by wart-like excrescences. It occasionally reaches 130 feet in height and 2½ to 3 feet in diameter, with slender zigzag branches, which form a round-topped head of pendulous branchlets.

The growth is rapid. It prefers a rich moist soil but will grow on rocky or gravelly soils. The leaves turn a light yellow in the fall. The fruit is a dark purple berry. It is comparatively free from insect and fungous attacks. The thriftiness and freedom from outside influence makes the tree a fairly good one for planting. Its form somewhat resembles the elm and it really should receive more attention as a shade tree than it has in the past.

MULBERRY.

Morus rubra.

(Other common name — black mulberry.)

This tree is found from Connecticut to Florida and west to Texas and Michigan.

The bark is dark brown and tinged with red, divided into irregular elongated plates which separate on the surface into thick appressed scales. The tree grows to be 60 to 70 feet high and 3 to 4 feet in diameter. The branches are stout and spreading and form a dense, broad, round-topped head. The shade cast is very dense. The leaves are dark blue-green in color and turn a light yellow in autumn.

It is rather rapid in growth, especially on good soil. It lives to be 300 years old. It is quite free from disease and insect troubles. It is very shade enduring. The fruit is the principal drawback to this tree for street planting, as the red berries, which much resemble blackberries, are continually dropping during July and make much litter. Otherwise this tree is an excellent one for shade purposes.

The white mulberry (Morus alba) is planted quite commonly in this country. The natural home of this tree is China.

CUCUMBER TREE.

Magnolia acuminata.

(Other common names — magnolia and mountain magnolia.)

This tree is found naturally from western New York and Illinois south along the Appalachian mountains. It will grow as far north as Ottawa.

It is a cone-shaped tree growing to a height of about 75 feet in New York. The rather small branches spread horizontally in the lower part of the tree, but are more erect above, coming out from a central straight axis. Three feet is a large diameter for the tree to attain in New York State. In some respects this tree resembles the tulip, the wood being almost identical.

The growth of this tree is quite rapid. The maximum age is about 200 years. Like the tulip it makes its best growth on deep, rich, moist soil, but will grow on poorer soils if the moisture conditions are right. It is quite intolerant of shade but free from insect and fungus.

This tree has quite an artificial appearance, owing to its regularity. The foliage is crowded at the end of the twigs. The tree is well adapted to single planting in open places. The flowers of this tree are formed on the old wood and to gain the advantages of the spring blossoming, it should be headed back after the flowering. This cutting back must be very carefully done in order not to weaken the tree. Only the small inferior limbs should be removed.

Great care must be exercised in transplanting this tree, as the roots are fleshy and the root hairs very delicate, so the roots will dry out unless very carefully handled. It is better to use small trees where possible.

This tree is an excellent one for ornamental purposes.

TULIP.

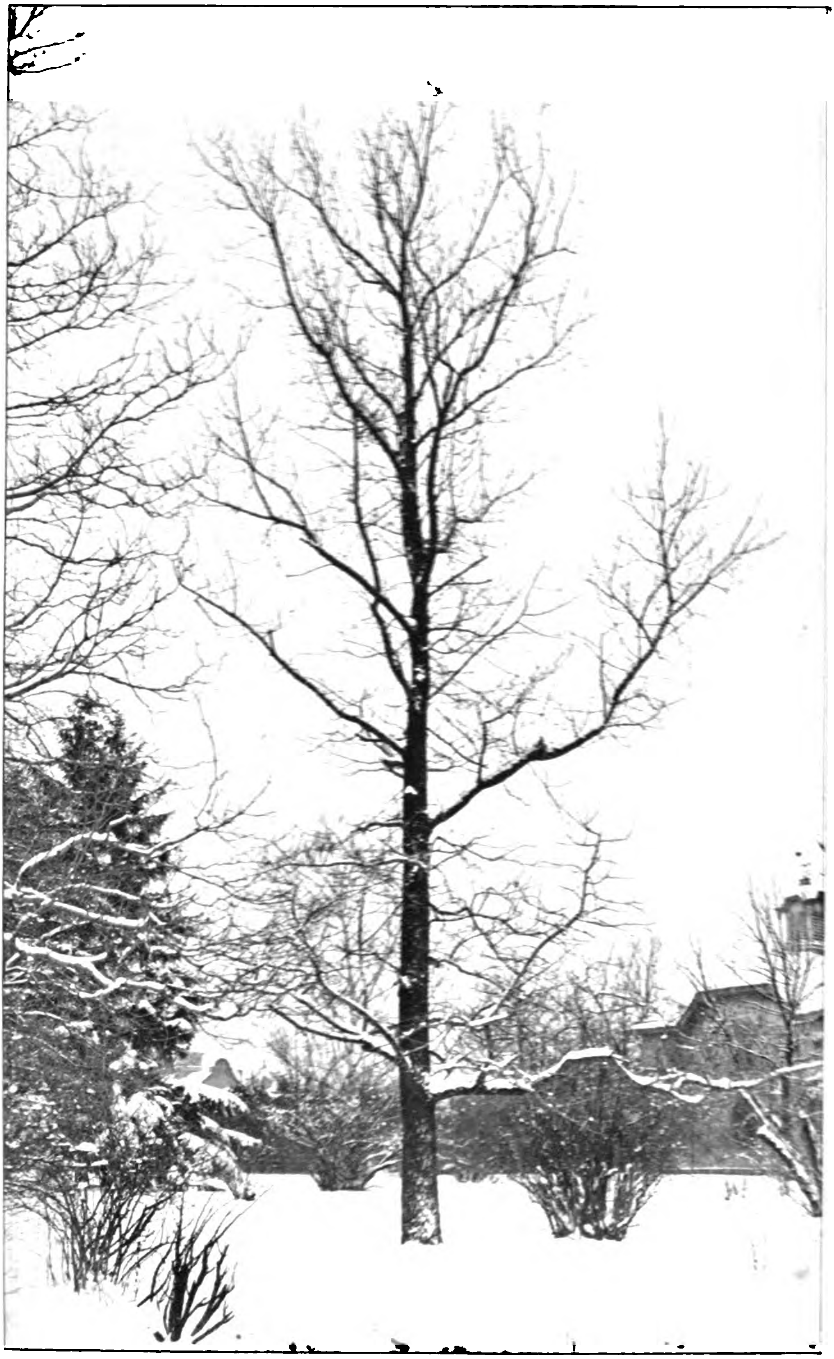
Liriodendron tulipifera.

(Other common names — white wood, yellow poplar, tulip poplar, cucumber tree.)

The natural range of this tree is from southern Vermont and Lake Michigan to northern Florida.

The tulip is probably the most regular in its growth of any tree we have. The trunk is one straight shaft, running to the top of the tree. The bark is brown and furrowed. On the best soils in the valleys of the Appalachians, this tree sometimes attains a height of nearly 200 feet. In the open, in New York State, 100 feet is a good height. The trunk grows to be from 4 to 5 feet in diameter. The branches are usually slender and give the tree a narrow pyramidal appearance in youth. They spread out, however, in old age.

The tree, in good situations, is a fast grower and lives to be 250 years old. The tulip does best on a true agricultural soil, although



Sweet gum

it will grow on poor situations if there is sufficient moisture. The tulip is very intolerant of shade and if planted in a group, it must be given light. It is remarkably free from insects and disease. The greatest defacement comes from wind break. If the tree stands in a public place, it is sometimes mutilated by persons desiring the flowers.

This is a most excellent tree for ornamental purposes and for shade. Its effect is better, back from the street. It presents a most formal appearance, with its slender, tall, straight trunk and regular branching. In the summer the leaves are a light green, turning in the fall to a golden yellow. The constant trembling of the leaves, as in the poplar, gives the tree an interesting appearance. The flowers look much like tulips and are a dark yellow streaked with orange or purple. It does not stand pruning well, and the tree must be transplanted when very small, else the roots will be dried out and the tree lost.

SWEET GUM.

Liquidamber styraciflua.

(Other common names — red gum, liquidamber, gum, starleaved gum, satin walnut.)

This tree is found from Connecticut to Florida and west to Missouri.

In the open, it grows to be about 90 feet high and 2 to 3 feet in diameter. The bark is light brown and tinged with red, deeply fissured into scaly ridges. The branches are slender and form a pyramidal head, becoming more or less round at maturity. The branchlets are small and pithy. The branches are always conspicuous from their corky wings. The trunk is full, regular and buttressed at the base. The root system is very shallow throughout its life.

Its growth is rapid, although varying much with the site. It lives to be nearly 200 years old. It will grow on almost any type of soil, but it must have moisture to do well. It will not, however, grow on swampy situations. Sprout reproduction is not very good. This tree is intolerant of shade and must be given full light if used in group planting.

The leaves are very beautiful in the autumn, varying from crimson to purple. In the winter the tree has rather an interesting appearance due to the ball-like, sharp-pointed, pendulous fruit hanging on through the season. The tree is free from insects and easily handled because of its shallow root system. After maturity, it sometimes becomes stag-headed.

This tree is an excellent one for shade and ornamental planting.

SASSAFRAS.

Sassafras sassafras.

This tree is found from Maine to Florida and west to Kansas.

The bark is dark red brown, deeply and irregularly divided into broad flat ridges. It grows to be about 80 feet high and sometimes reaches 6 feet in diameter. The branches are short, stout and more or less contorted. They grow nearly horizontally. The crown is narrow and flat topped. The species often grows in dense thickets, due to its ability to reproduce by suckers.

It grows rapidly and prefers a rich, sandy loam, so that the fleshy roots may penetrate deeply. This tree will grow on any loose, moist soil. It is rather a picturesque tree when grown and in the autumn, when the leaves turn yellow and red, it is quite striking. The leaves are of different shapes and present quite a variation. The wood, bark and roots are all aromatic. The yellowish flowers in early spring and its very long leaf period, add to the ornamental value. This tree is best fitted to plant away from the street.

SYCAMORE.

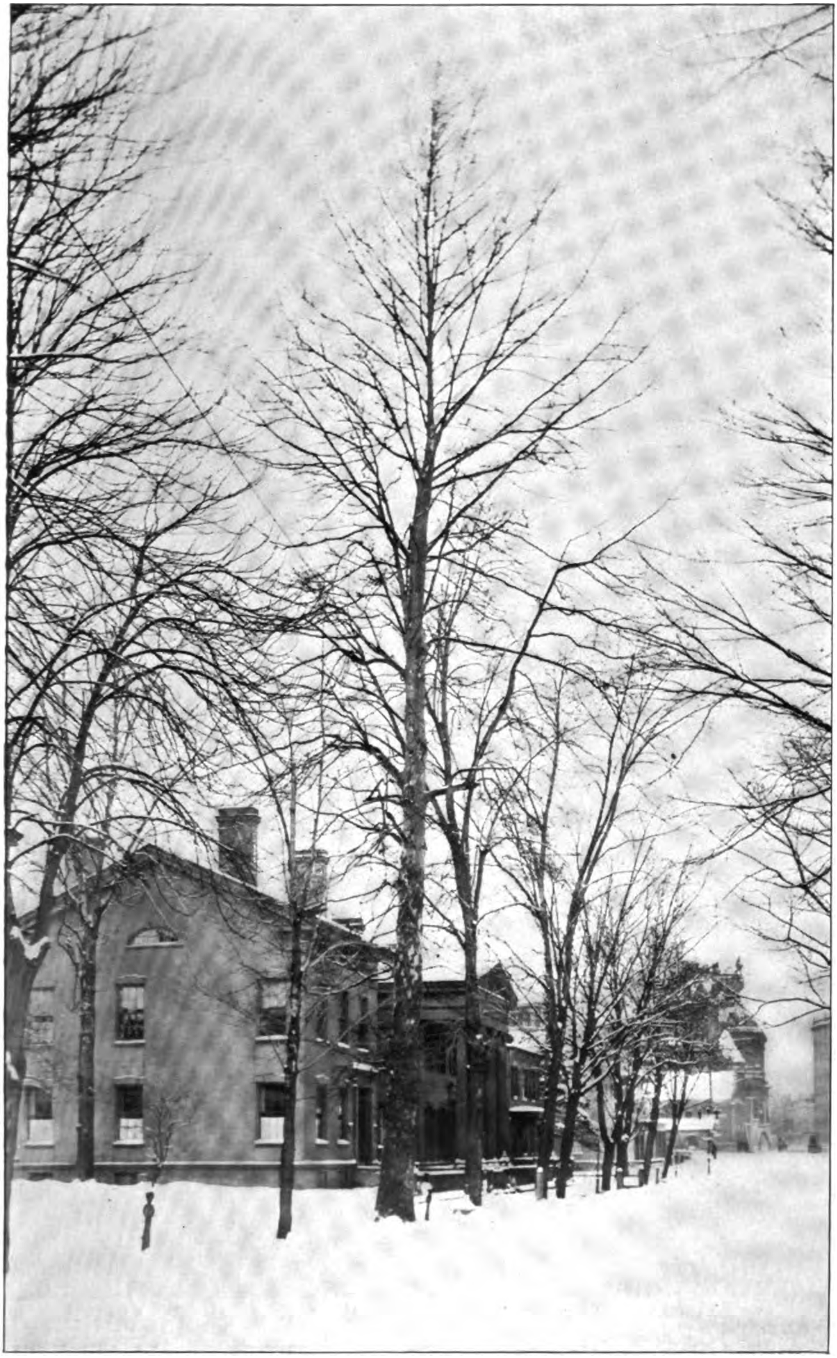
Platanus occidentalis.

(Other common names — buttonwood, buttonball, plane tree.)

This tree is found throughout the eastern hardwood forest area.

The bark is reddish brown, broken into small, oblong, thick scales. In the young trees, however, the bark is smooth and light gray and separates into thin scales, which fall off to expose large irregular patches of pale yellow, whitish or greenish inner bark. This is a large tree and grows to be 140 to 170 feet high and 10 to 11 feet in diameter. It either divides near the ground into several secondary trunks, or rises 70 to 80 feet free of branching. Massive spreading limbs form a broad open irregular head, sometimes 100 feet in diameter. The extremities are erect or pendulous. The root system is shallow and spreading. The trunk tapers very fast and is seldom straight.

The growth is rapid and the tree lives very long. It is not uncommon to find it 600 years old. It is very intolerant of shade and requires full and direct sunlight for growth. It dies if



Sycamore

overtopped. It is particularly subject to butt decay and the ultimate branches are injured by a fungus, causing them to have a gnarled appearance. A late frost will cause the first crop of foliage to drop off. In the autumn the leaves turn brown and wither before falling.

The shedding of the bark makes the tree easily recognizable, as well as interesting, as the process is more noticeable here than on any other tree.

It bears transplanting well and is able to withstand the hard life of a street tree. It demands moisture and a rather good soil for successful growth. This is a fairly good tree for street planting, but should never be used on narrow streets owing to its very large size. The greatest drawback to the use of this tree is the liability to attacks by a leaf fungus which may cause the tree to lose its leaves in the late spring.

CHERRY.

Prunus serotina.

(Other common names — black cherry, wild cherry, rum cherry.)

This tree is distributed from Nova Scotia south to Florida and west to Dakota and Texas.

The dark red brown bark is aromatic and broken up into small plates, which are scaly at the surface. It grows to a maximum height of 100 feet, but is usually about 50 feet high. It has a maximum diameter of 4 to 5 feet. The branches are slender and form an oblong crown. In old age the crown is very open and but little shade is given. The spray is fine and pendulous. The trunk of the tree is usually not well defined in the crown.

The growth is rapid on good soil. The tree often adds one inch per year to its diameter. It lives to be 200 years old. The tree is not exacting as to soil and moisture; a poor soil, however, causes scrubby growth. The tree sprouts poorly. The deep, wide spreading root system of this tree makes it quite wind firm. In the spring the flowers are small and white. The leaves turn a clear pale yellow in the autumn.

The tree is intolerant of shade and in group planting it must be given the advantages of full light. It is severely injured by a fungus known as the black knot, which attacks the twigs and branches. It is attacked to some extent by wood borers, particularly those working at its roots. The fall web worm also does more or less damage.

The tree is not adapted to street planting, but should be planted in yards where there is a deep, sandy soil to be used. One drawback to this tree is the litter caused by the falling fruit in the fall, which makes it particularly unclean when used for street planting.

KENTUCKY COFFEE TREE.

Gymnoclaudis dioicus.

(Other common names — coffeenut, mahogany.)

The name coffee tree comes from the early use of the seed of this tree as a substitute for coffee. The tree is distributed naturally from southern New York south to Arkansas, but it is hardy as far north as Ottawa.

The tree has a very luxuriant tropical looking foliage, much like the Ailanthus. The bark is finely fissured. The trunk divides 8 to 10 feet from the ground into three or four principal stems and forms a stout but ragged and straggling branch system. It reaches a height of 100 feet and a diameter of 2 to 3 feet. The tree requires a deep, rich soil, as it forms a deep, wide spreading root system.

Its growth is rapid. It requires a moderately moist soil and will not grow in either a wet or a dry soil. It lives to be about 120 years old. Reproduction is wholly by seeds. This tree requires full sunlight. It is little affected by disease or insects.

In the autumn the leaves turn a clear yellow. The tree is wholly destitute of spray, which gives it a very clumsy appearance in winter. Buds appear to be lacking and it looks, on the whole, much like a dead tree. It is one of the last trees to leaf out in the spring. The leaf is doubly compound, a rare character in a tree leaf, and when they are expanding the tree is very conspicuous, as the youngest ones are a bright pink while the older ones vary from bronze to green.

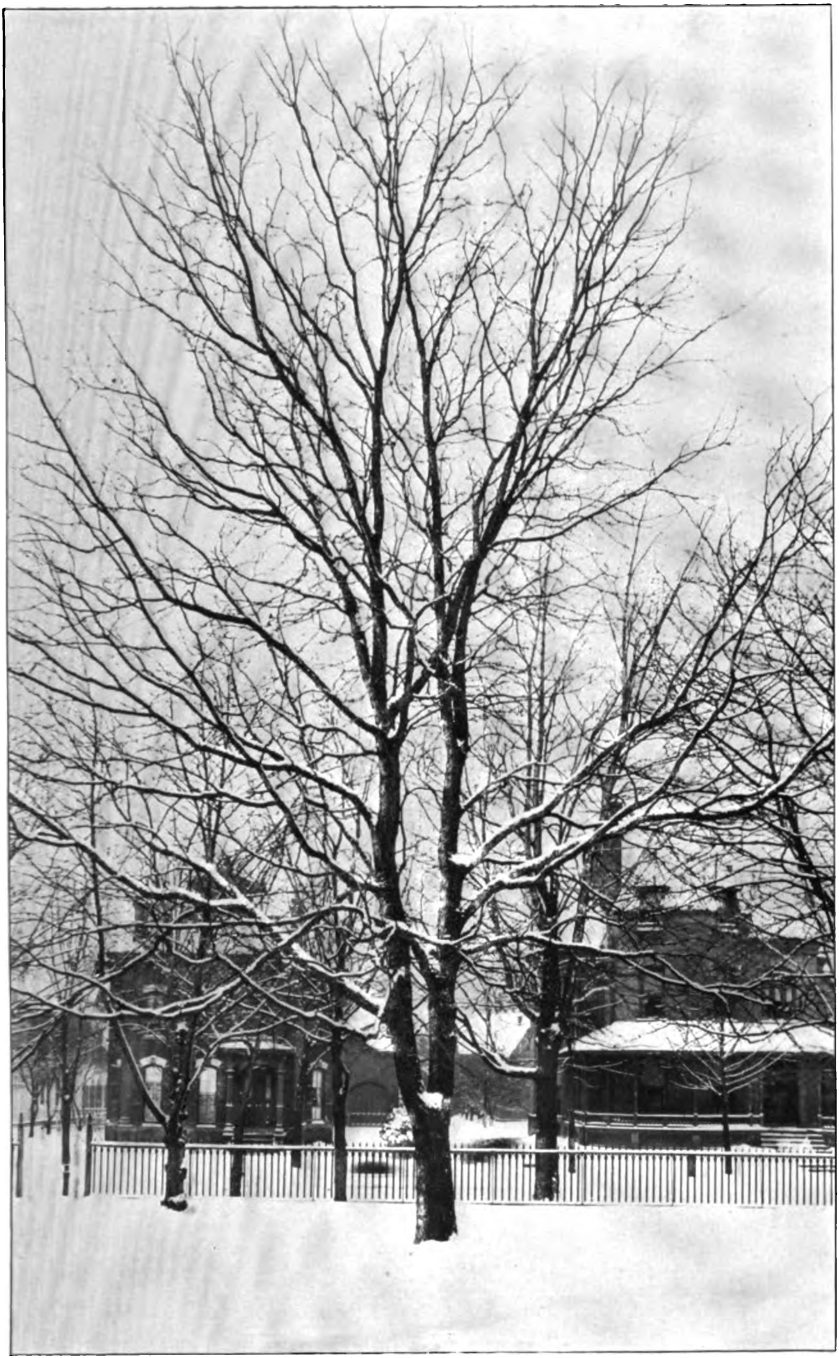
The drawbacks to the use of this tree are mainly its winter appearance and exacting soil requirements. It would do better for lawn planting than street planting.

HONEY LOCUST.

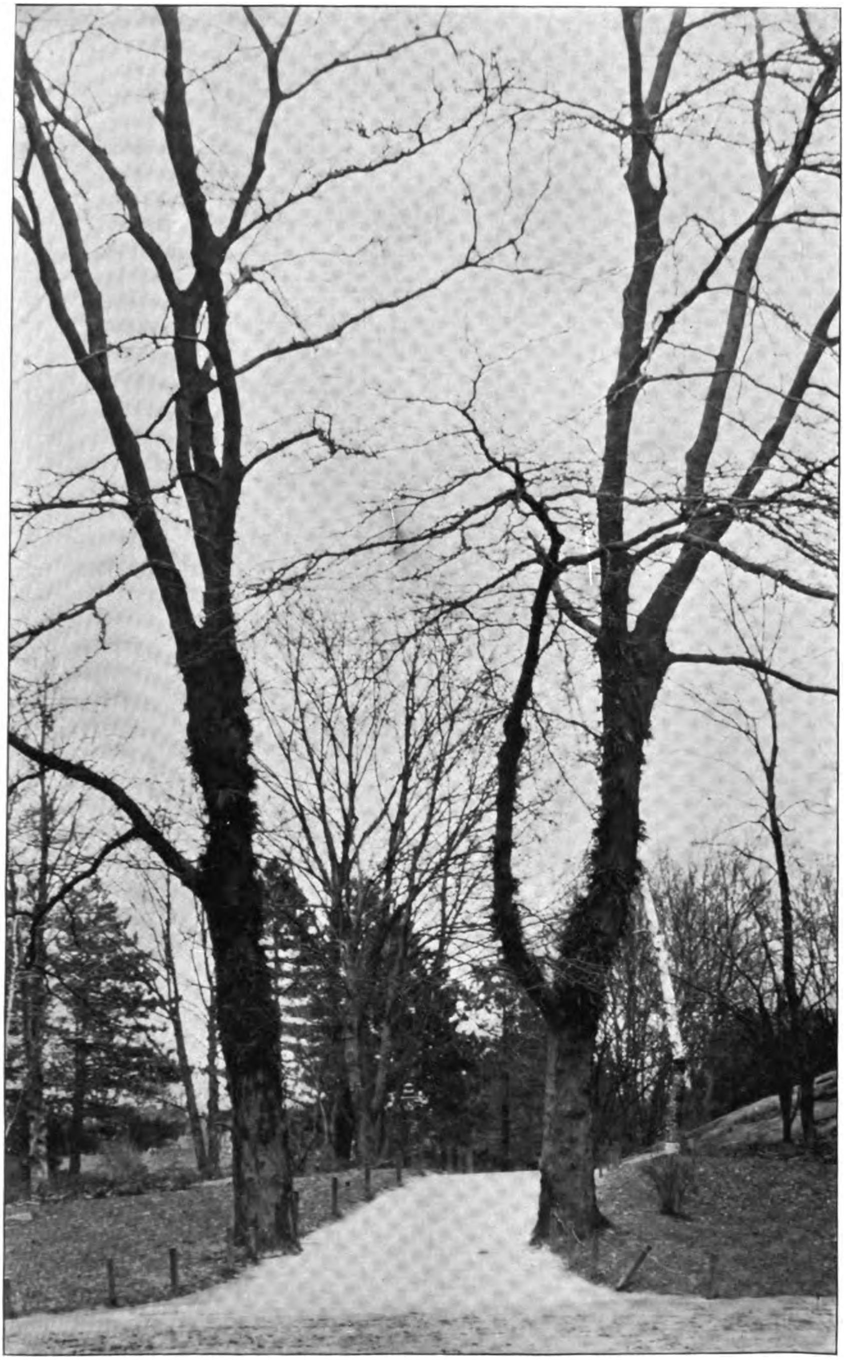
Gleditsia triacanthos.

(Other common names — sweet locust, black locust, thorny locust.)

This tree is distributed over the eastern hardwood forest area. It is a tree 75 to 100 feet high and 2 to 3 feet in diameter with a



Kentucky coffee tree



Honey locust

narrow, rather flat-topped head. The branches are spreading and rather pendulous and they are protected by simple or three-forked spines. It has a deep, rather wide spreading root system. It is without a well defined axis and usually branches low.

The growth is rapid. To attain a good growth it must be on a fresh, good soil. It grows very slowly on a dry gravelly soil. It lives to be 120 years old. It is very intolerant and must not be planted in the shade.

The flowers of this tree are inconspicuous. The fruit, in the form of large pods, hangs on the tree most of the winter, falling gradually. The foliage is a light green and turns to a clear yellow in the fall. The tree is free from insects, thus having a decided advantage over black locust. The effect of the whole tree is more delicate and more beautiful than that of the black locust.

This tree has much in its favor as a shade tree and if the soil is good it can be used with very satisfactory results.

LOCUST.

Robinia pseudacacia.

(Other common names — black locust, yellow locust.)

The natural range of this tree is from Pennsylvania south along the slopes of the Appalachian mountains to Georgia.

The locust grows to be 75 feet high and 3 to 4 feet in diameter. It usually forms a narrow, oblong head, although this form varies much with the soil conditions. The branchlets are slender. The tree is very liable to spread by underground shoots. The roots are very shallow and extend 40 to 60 feet from the tree.

The tree is one of the most rapid growers we have and adapts itself to all kinds of soil conditions. It is mature at 20 to 35 years and rarely lives over 80 years.

The leaf is compound and gives the tree a beautiful appearance in summer, which is quite in contrast with the winter condition, as the trunk is twisted and the branching irregular, while the persisting seed pods are most unattractive. In autumn the leaves turn a pale yellow, and are often shed with whole branchlets.

It should be pruned after flowering in the spring, if the full beauty of the large, pendant, fragrant white clusters is to be realized. Pruning at this time of the year must always be done with great care.

If fast growth were desired this would be a very good tree to plant were it not for the ravages of an insect known as the locust borer, which attacks this tree as soon as it is three or four years old. The trunk is riddled with the borings, which gradually weaken the tree and deform it, at the same time laying it open to disease, so that it is very short lived and usually a total failure. A leaf fungus also often attacks this species.

This tree is not suitable for street planting and when used it should be in yards in groups or where the soil is extremely poor. The habit of excessive suckering is also against the use of the tree.

AILANTHUS.

Ailanthus glandulosa.

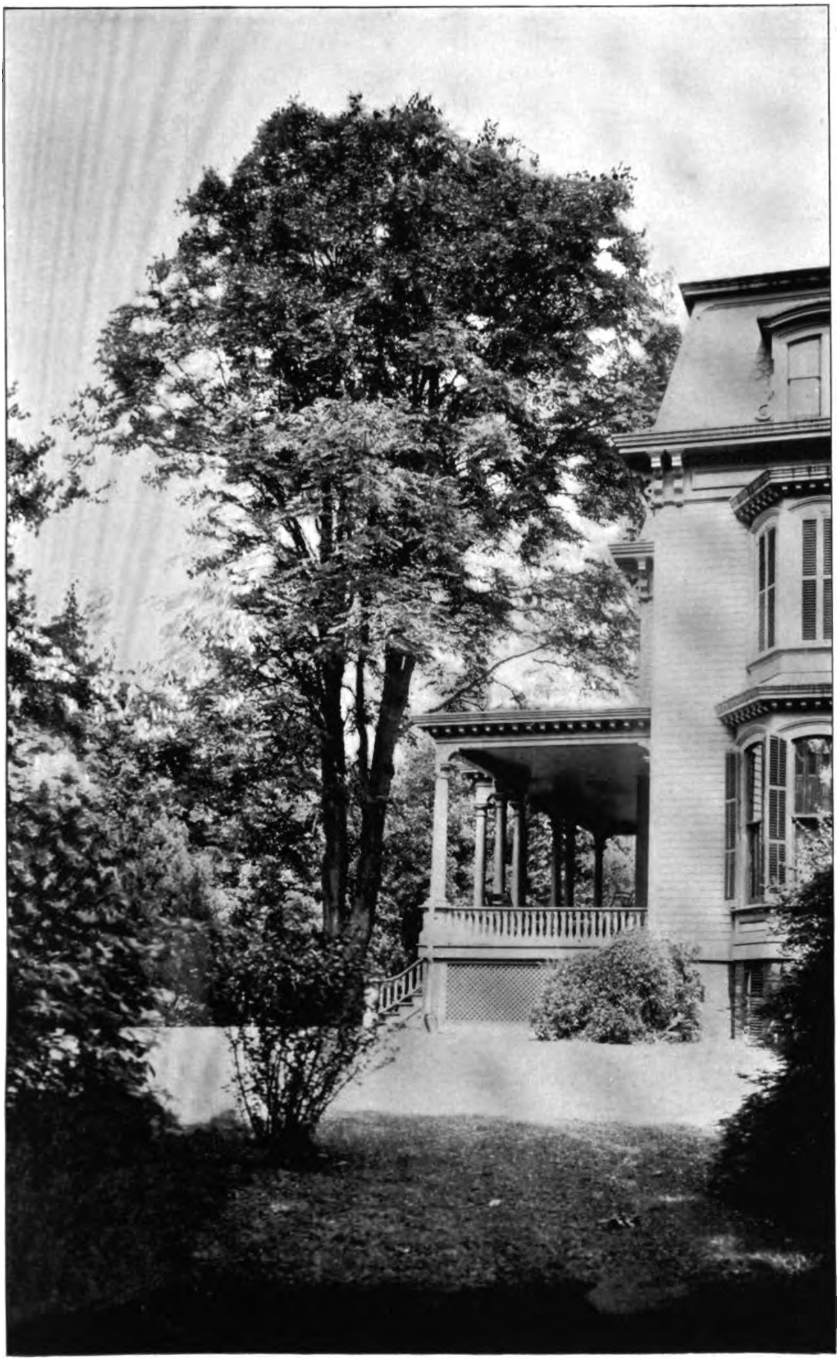
(Other common name — tree of heaven.)

This tree is a native of China but grows very successfully in this country. It is a tree 50 to 75 feet high with a very irregular, picturesque head. The bark is brownish gray with shallow fissures. The branchlets are clumsy and stout. It reminds one very much of a large sumach.

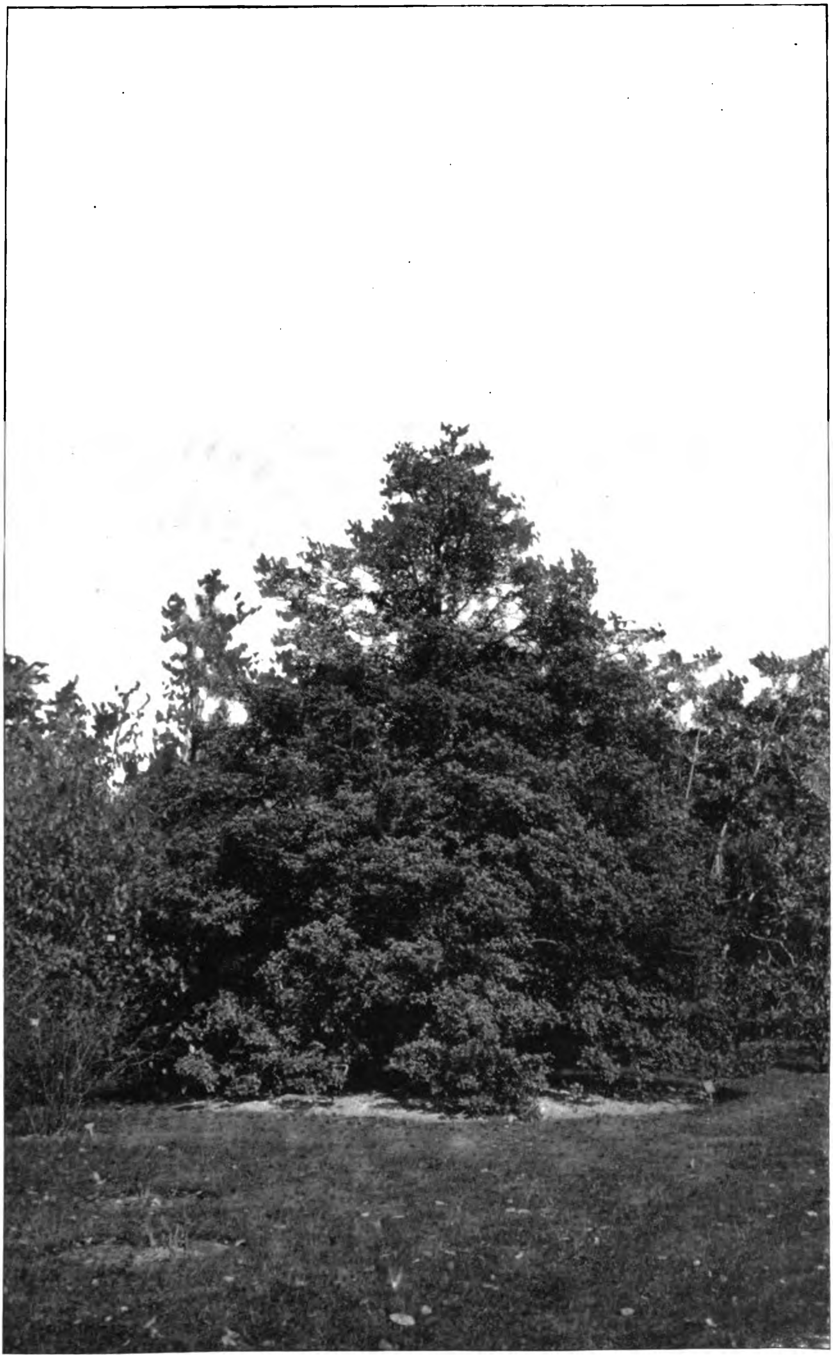
It grows very rapidly but is short lived. It will grow under very adverse conditions. It is often seen in the cities, growing in the spaces between house and sidewalk, having taken root in a crack in the flagging. The tree needs a great deal of light for proper growth. The leaves are compound and very large, being from ½ to 3 feet long. In the fall they turn a lemon yellow, if they change color at all. The tree looks very clumsy in winter because of the entire absence of spray.

There is much to say for and against this tree as a shade tree. It is quite desirable where rapid growth is wanted, often making 4 to 6 feet in a single season. The fresh green is retained by the leaves until late in the season. It has apparently no insect enemies. Against these good points are the facts that it is short lived, usually hollow butted, easily wind broken, and above all, the male trees give off a powerful and disagreeable odor. If one is going to plant this species he must be sure to get the pistillate variety. It suckers very readily and has to be used with discretion if planted near pavements.

As a tree simply to withstand the hard knocks of the city this is probably the best.



Black locust.



White holly

STAGHORN SUMACH.

Rhus hirta.

(Other common name — hairy sumach.)

The name staghorn comes from the form of branching, which is stout, upright and contorted, forming a low, flat open head. The bark is smooth and dark brown. On older trees the bark is sometimes scaly. Its branchlets are thick and covered with long, soft brown hairs. There is no other native tree which has such a velvety covering on the twigs as this tree. It reaches a height of 40 feet only very rarely. The maximum diameter is about 1 foot. It spreads by suckers and usually appears little more than a shrub.

It grows very rapidly but is short lived. A calcareous soil is preferred. The beauty of the tree lies entirely in its foliage. The leaves are pinnately compound and borne in tufts at the end of the branch, from which they hang down. In the center of each tuft is a panicle of bright red fruit. The coloring is very brilliant in the fall, scarlet, gold, crimson and orange being blended together. In the winter the tree has a very clumsy appearance.

This tree should never be set out near the street. It shows the best effect in group planting for landscape work.

HOLLY.

Ilex opaca.

This is an evergreen tree growing from New York to the Gulf of Mexico. In the northern part of its range it is much dwarfed. Its height in New York State is seldom 25 feet. The branches are short and slender, forming a narrow pyramidal head. It grows very slowly. It will grow on both dry and swampy soil. The roots are thick and fleshy. The bark is light gray. The leaves are persistent on the tree for three years and are edged with spiny teeth. The tree is very tolerant of shade and would do well as an underplanting.

The tree does not transplant easily when old, as it has a very deep root system. It is free from insects, but is liable to sun scald and frost injury. If it is to be used care should be taken to select female trees, as the berries add greatly to their beauty.

NORWAY MAPLE.

Acer platanoides.

This tree was first imported from Europe. It is the nearest, in outline, habit and form of foliage to the sugar maple of all the maples. It seldom grows over 60 feet tall and has a broad, round head. The bark is rather dense and finely fissured. The roots are wide spreading and deeply penetrating. It is the earliest bloomer of all maples. The flowers are greenish yellow and appear as pendulous clusters, giving the tree a very beautiful appearance. The dark leaves stay on the tree quite late in the fall, about two weeks later than the native maples, but the fall coloring is not as brilliant, as the leaves turn yellow and fall with little change.

The tree grows rapidly and adapts itself to any soil or moisture condition. It is very resisting to rot and insects. It is a tree of medium size and well adapted to all streets except the narrow ones.

This is one of the finest shade trees that we have.

RED MAPLE.

Acer rubrum.

(Other common names — soft maple, swamp maple, white maple.)

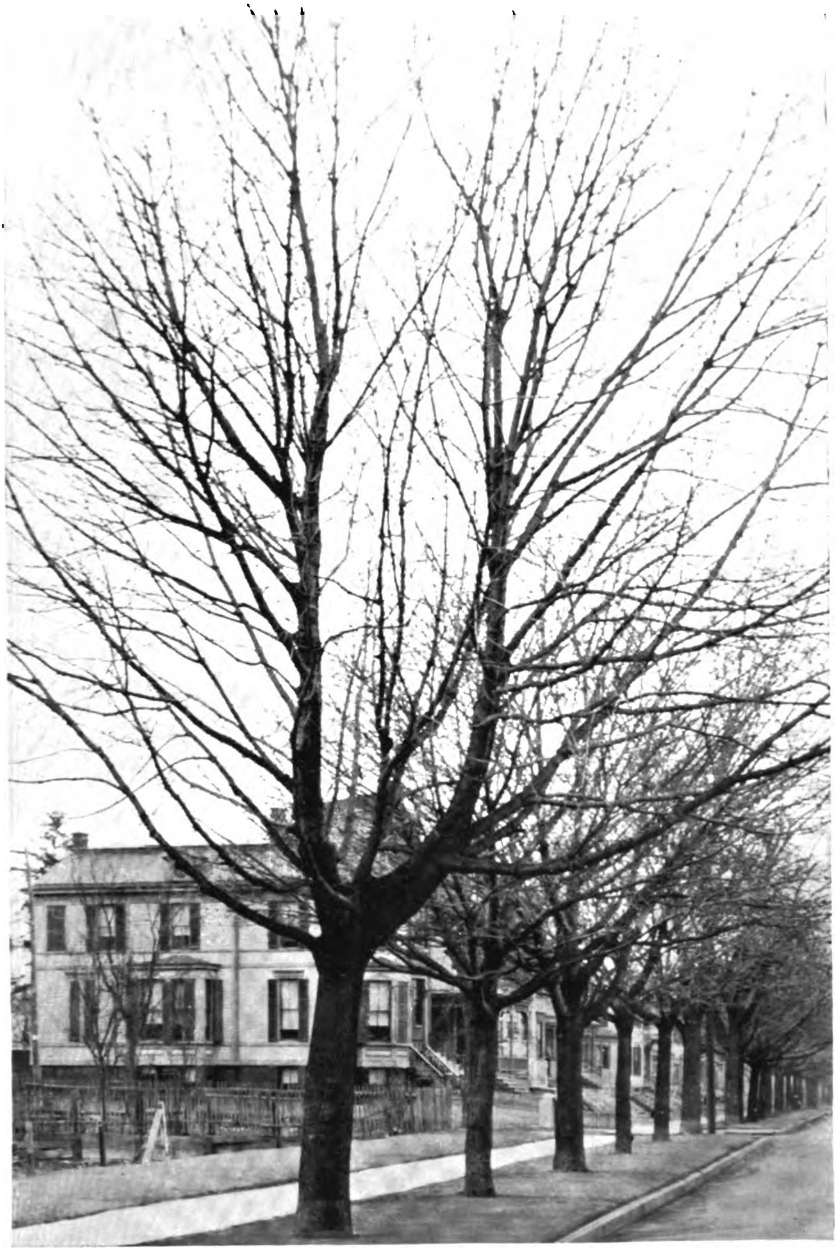
This tree is distributed from Canada south to Florida and Texas.

The bark is dark gray and divided into longitudinal ridges which separate into large scales. The branching is upright, usually forming a rather narrow head. It seldom grows as high as 90 feet and 3 feet is a large diameter for it to attain. The trunk to the first branches is 8 to 10 feet long.

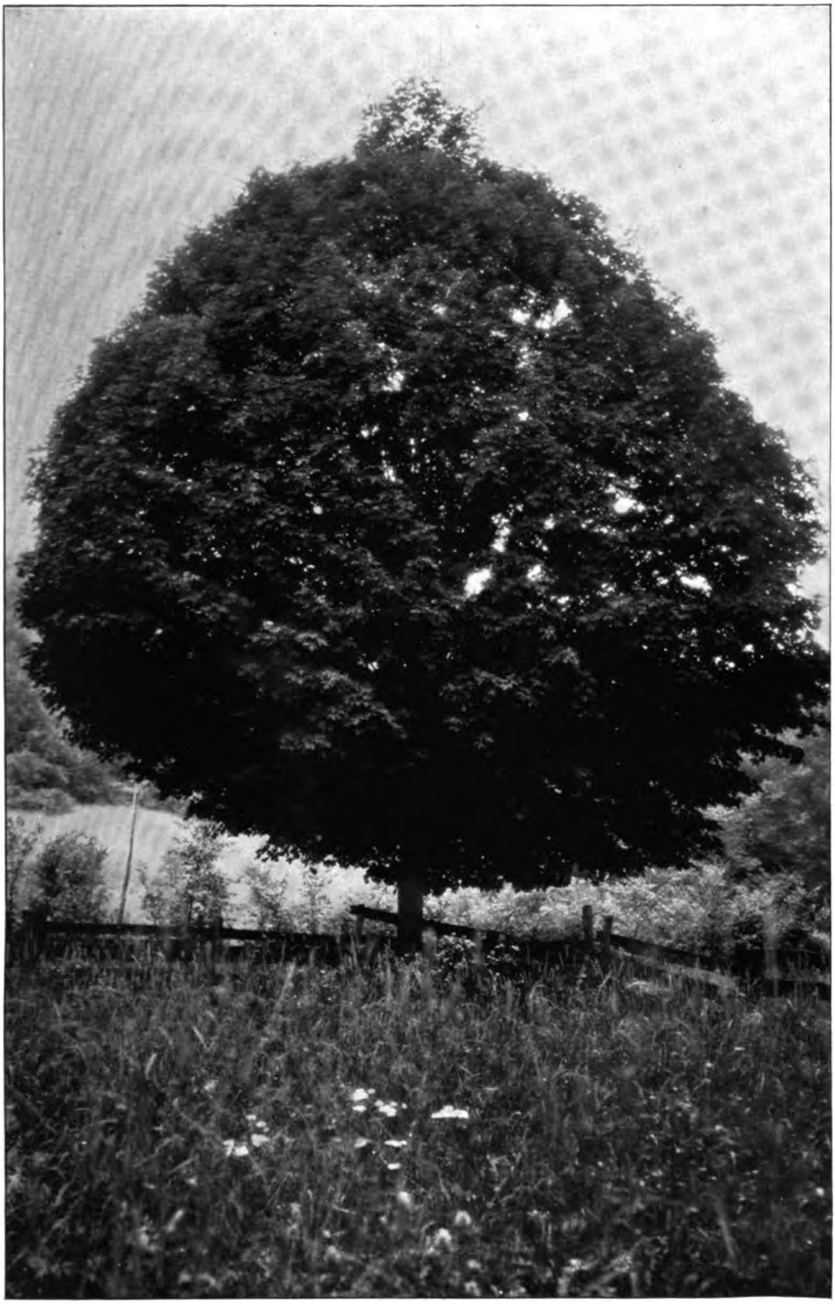
It grows rather rapidly at first, sprout growth being particularly rapid. It will grow on a variety of soils. It prefers a wet situation, where its root system is spreading and superficial. On drier situations it does very well, the roots penetrating much deeper. The shade tolerance of the tree varies a great deal, but it will not stand shade quite as well as hard maple. It is very subject to heart rot.

It puts out bright red flowers in April, being about the first tree to bloom. During the summer the leaves are a dark green above and pale green to white underneath. In the fall it is the first tree to turn the color of its foliage, which is then a brilliant red or scarlet.

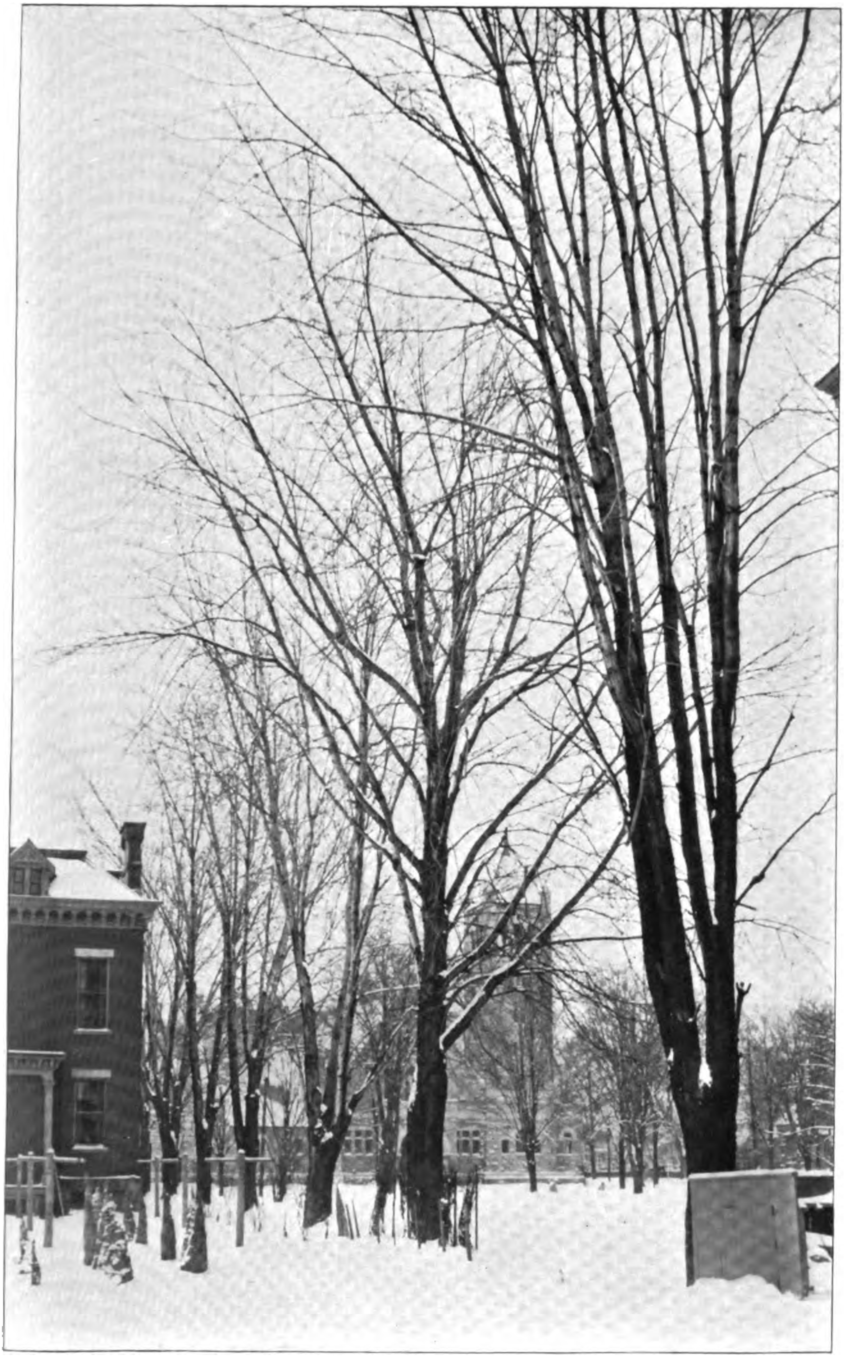
If this tree is to be planted it would be better suited to narrow streets. On the whole, however, it is not a good species to use in any planting, as it is not as hardy and long lived as the sugar maple.



Norway maple



Sugar maple



Silver maple

SUGAR MAPLE.

Acer saccharum.

(Other common names — hard maple, rock maple.)

This tree is widely distributed over eastern North America. It stands as one of the most popular trees we have for street planting.

It grows to be 100 to 120 feet high and 3 to 4 feet in diameter. The branching usually begins 8 to 10 feet from the ground, where the main trunk is split into several stout upright branches. These divide again and again, forming a round-topped dome 70 to 80 feet across. The bark is light gray brown and broken into deep longitudinal furrows. Large fibrous roots are formed which penetrate very deeply into the soil in old age. Its growth is rapid. The tree needs a fairly moist soil but it will grow under varying conditions. It is particularly suited to lime and clay soil. It lives to be 200 to 350 years old. It is quite tolerant of shade and will do well in close planting. The foliage is dense and it makes one of the most useful and pleasing of American hardwood trees. The fall color of the hard maple is most beautiful, varying from a yellow to a deep crimson. The tree furnishes most of the maple sugar of commerce and can be tapped for sap without injuring its vitality.

It often suffers severely from wood borers, which partially girdle the tree and weaken it for the easier attack of fungi and make it more liable to wind destruction. There are few old trees that escape disfigurement on this account. Maple is more resistant to gas poisoning than most other trees. Owing to their free bleeding, maples should be pruned in late summer.

The sugar maple is one of the finest trees we have for street planting.

SILVER MAPLE.

Acer saccharinum.

(Other common names — soft maple, white maple, swamp maple.)

This tree grows to be from 90 to 120 feet tall and attains a diameter of 3 to 4 feet. The trunk usually divides 10 or 15 feet from the ground into three or four upright secondary stems, destitute of branches to a considerable height. The crown is open, straggling and spreading and yet more or less graceful, with long slender, often pendant branches. In form, this maple somewhat resembles the elm, the character of the branches being much the same and the bark having much the same appearance. The root system is similar to that of the sugar maple.

Its growth is rapid, especially on rich loam. It does well on a sandy soil, but is usually slimmer under such circumstances. It cannot be planted on dry, upland sites. The sap of this tree also produces sugar.

When shade is wanted quickly, this is a very good tree to plant. It has one drawback in being liable to wind and snow break. Much of this trouble can be prevented, however, by careful pruning. It is comparatively free from disease.

The silver maple is one of the first trees to blossom in early spring. The leaves are a pale green above and silvery white beneath. In the fall the leaf coloring varies from yellow to scarlet.

This is an excellent tree for planting purposes, as it combines all the desired features, being easily transplanted, stands pruning well, is very graceful and is most pleasing in summer because of the silvery coloring of the leaves, while the fall coloring is very striking.

BOX ELDER.

Acer negundo.

(Other common names — ash leaved maple, cut leaved maple.)

This tree is found naturally from New York south to Florida and west to the Rocky Mountains.

The bark of the tree is a pale gray or light brown, divided into broad, rounded ridges. It grows from 50 to 70 feet high and up to 3 feet in diameter. It divides rather low down into a number of stout wide spreading branches, with slender branchlets. It is the only maple with compound leaves.

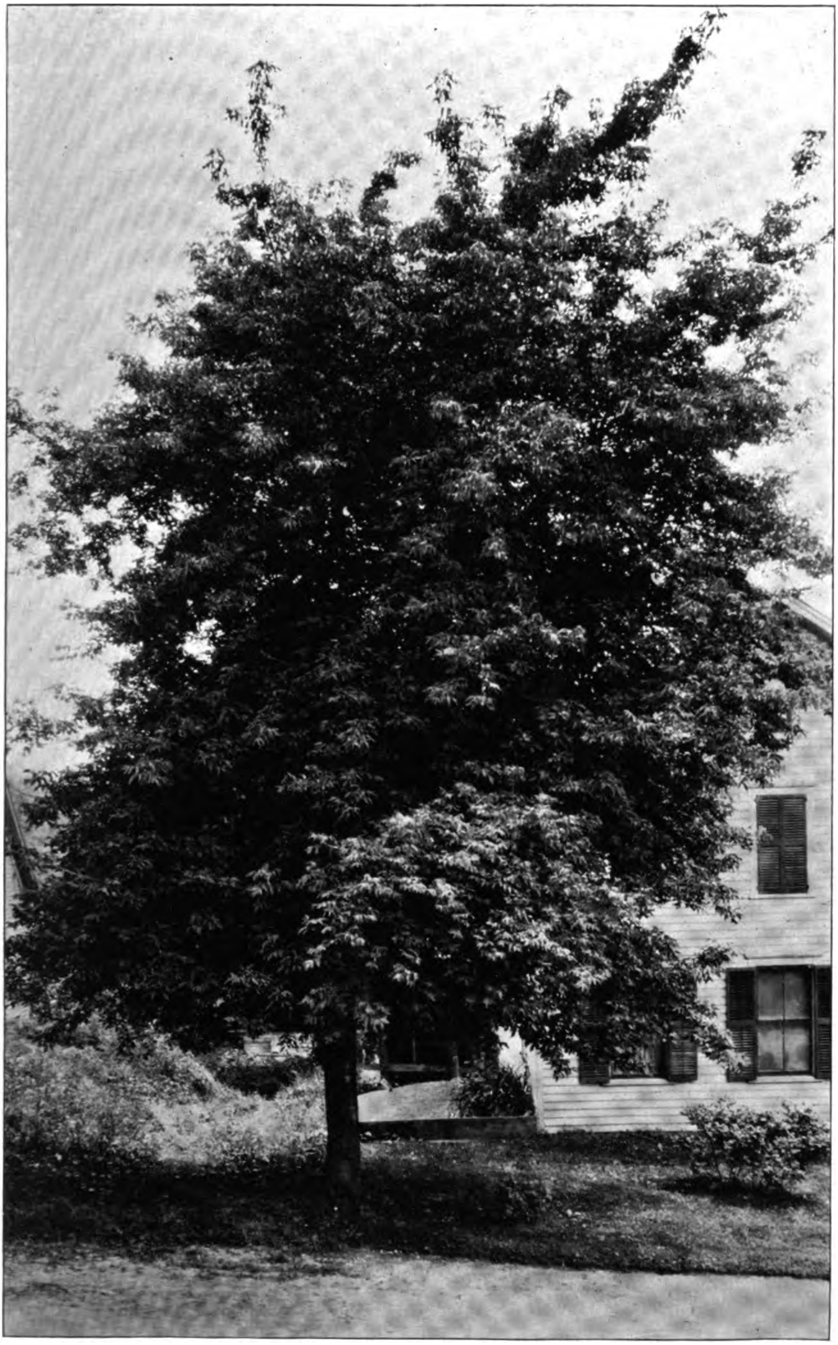
Its growth is very rapid; it often makes 1 inch in diameter each year for the first 15 years. It is adapted to all soils except extremely wet ones. It is short lived. It is usually shallow rooted. It is much subject to breakage by wind, snow and sleet. Heart rot is frequently met with. It is not a tolerant tree.

In autumn the leaves turn a pale yellow. If this tree is used it would be more suitable for narrow streets. Planting of the box-elder, however, is not strongly advised.

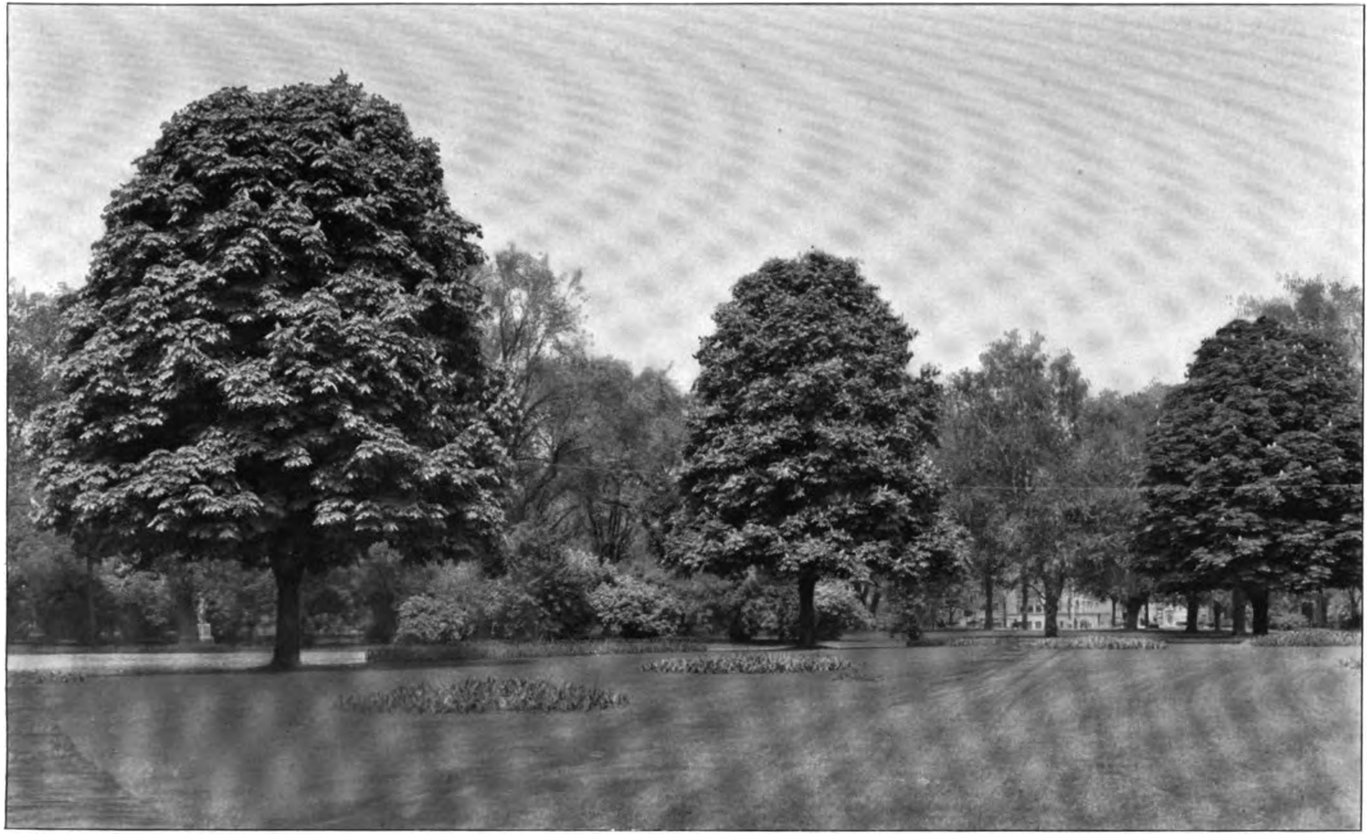
HORSE CHESTNUT.

Aesculus hippocastanum.

This tree was introduced from Greece and has become much used in street and ornamental planting. The bark is dark brown and roughened. The trunk is erect and the branching regular,



Box elder



Horse chestnut

forming a cone-like head. The branches usually curve up from the trunk, then down, with the tips turning up again. The spray of the tree has a coarse appearance, the branchlets being tipped with a large resinous bud.

It is one of the first trees to leaf out in the spring. The leaves are large and form a dense shade, and shortly after their appearance the tree is covered with large pink and white flowers, which make it very noticeable. In the fall the leaves turn an orange color.

As to rapidity of growth, this tree is about midway. It does well under average soil and moisture conditions. The fruit is borne in a round prickly ball. School children like to gather the nuts and if the tree stands on the street, it is liable to mutilation from this source. It suffers from quite a serious fungous disease, which attacks the leaves.

This is a very acceptable tree for street and ornamental planting.

BASSWOOD.

Tilia americana.

(Other common names — linn, linden and white wood.)

This tree is found scattered through the forests from Virginia to the southern shores of Lake Winnipeg.

The bark of the tree is deeply furrowed, light brown and broken into thin scales. It usually grows 60 to 70 feet high and the trunk attains a diameter of 3 feet. The branches are often pendulous and form a round topped head. The trunk is usually erect. The leaf is heart shaped and rather large. The tree gives much shade.

It grows rather fast and lives at times to be several hundred years old. Moisture is the most important consideration in the growth of this tree. A deep tap root is formed, but if conditions make it necessary, this is easily broken up into lateral roots.

The tree is quite liable to insect attacks. Oftentimes when the leaves are shed in the fall, branchlets from 1 to 10 years old come off. The tips of the branchlets are often frozen and killed in the fall. This freezing is due to the frost coming before the new wood is sufficiently hardened. This can be prevented by defoliating the branchlets before growth ceases.

The tree is easily transplanted and sprouts vigorously from the stump. In the spring the flowers of the tree are quite fragrant. Honey from the basswood blossoms is particularly sought after. In the fall the leaves turn a pale yellow. The winter appearance of the tree is quite graceful.

This tree is recommended for use as a shade tree.

BLACK GUM.

Nyssa sylvatica.

(Other common names — sour gum, tupelo and pepperidge.)

This tree is found from Maine to Florida and west to Missouri. The bark is light reddish brown, deeply furrowed and scaly. The tree gets to be 100 feet high on the best situations and sometimes reaches 5 feet in diameter. There are many slender branches, pendulous at the bottom and horizontal higher up, forming a head sometimes short and cylindrical and sometimes low and broad. The growth is symmetrical in youth. The root system is shallow and spreading. In old age the form becomes straggling and the branches become irregular and picturesque.

The growth is fairly rapid and the tree lives to be 120 to 150 years old. The soil is not an important factor to its growth if there is plenty of moisture present throughout the year. The tree is intermediate as to its shade tolerance. It is more tolerant than the chestnut and white oak, but becomes less tolerant with age.

At maturity the tree begins to grow stag headed and is subject to fungous troubles. It is often wind thrown. In the fall the foliage is very brilliant, being scarlet or yellow and scarlet. It does not transplant well unless properly prepared in the nursery.

This tree does not grow well on an exposed situation and is not a first-class tree for street planting.

FLOWERING DOGWOOD.

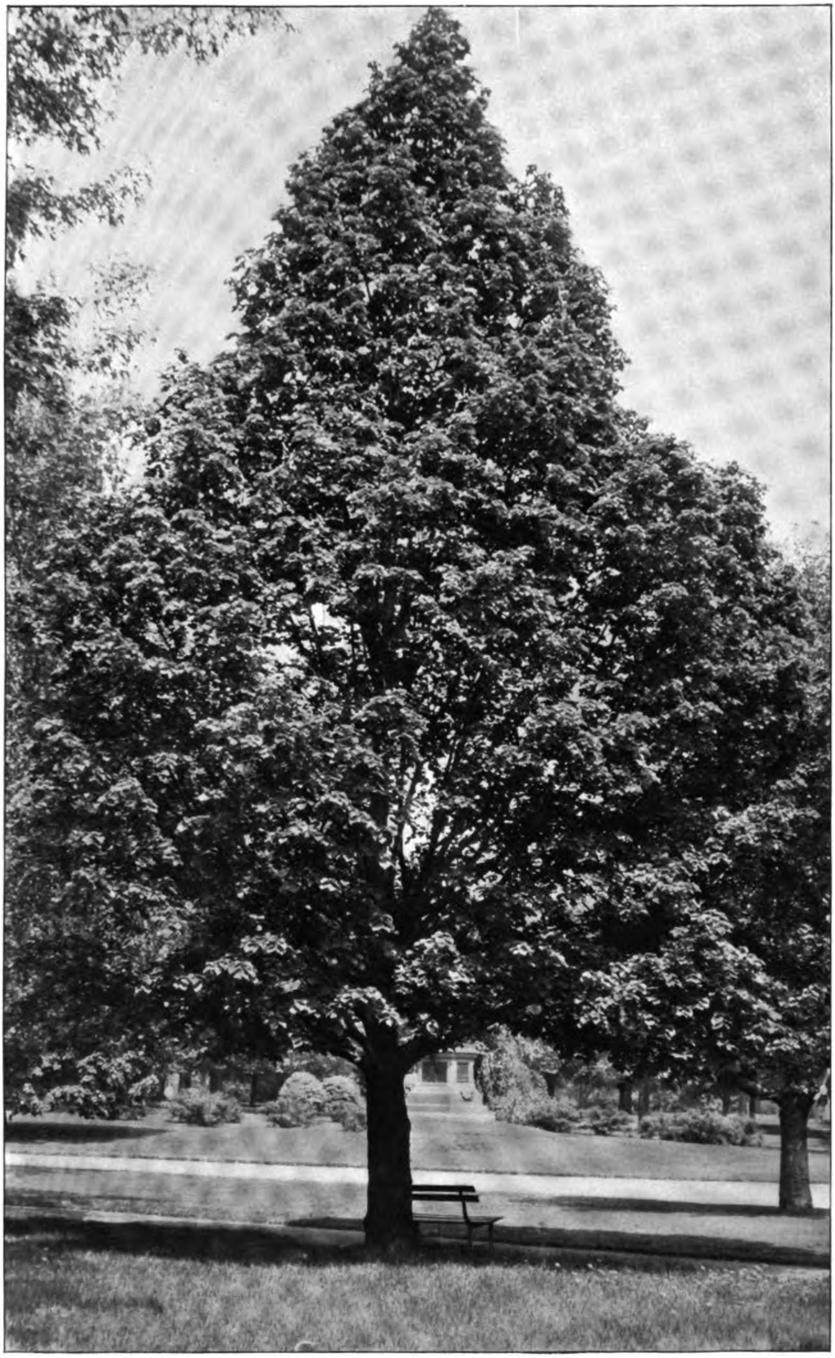
Cornus florida.

(Other common names — dogwood, boxwood.)

This tree is distributed from Massachusetts and Kansas to Florida and Texas.

The bark is dark red brown divided into quadrangular plate-like scales. It rarely grows more than 40 feet high and 12 to 18 inches in diameter. The branches are slender, spreading and upright. The branchlets turn up near the ends.

The flowers of this tree are very showy, large and usually white. The fruit is a bright red or scarlet berry. The leaves turn a



European linden

brilliant scarlet in the fall. The tree is tolerant, but it is quite particular as to the soil. The growth is very slow. It is free from insect trouble.

The dogwood is a good one for group planting where contrast is desired, but it should never be used for street planting.

PERSIMMON.

Diospyros virginiana.

This tree is found from Connecticut to Florida and west to Kansas.

The bark is brown tinged with red and deeply divided into thick square plates. It grows to be 30 to 50 feet high and 12 inches in diameter. The branches are spreading and pendulous, forming a broad round-topped head. The trunk is well defined through the crown. The root system is deep and wide spreading, with many surface roots. It thrives best on a deep rich soil, but the growth is slow. It is quite intolerant of shade.

The leaves sometimes fall without change of color, sometimes change to orange or scarlet. The fruit is quite noted and looks something like a brown plum. It requires great care in handling from the nursery to the planting hole, as the roots are very delicate and the tree is often lost because of the roots drying out.

It is best used in group planting back from the street, as its shape and habits make it unfit for street planting.

WHITE ASH.

Fraxinus americana.

This tree is found through the eastern hardwood forest area.

The bark is gray tinged with red and divided into broad flat ridges. It grows up to 120 feet tall and 5 to 6 feet in diameter. The branches are upright or spreading, forming a round-topped pyramidal head. The trunk is straight and clear cut. The root system is deep and spreading.

The rapidity of growth is intermediate and depends much on the soil conditions. A porous moist soil is best for the successful growth of white ash. The tree is intolerant of shade. It is wind firm and usually free from fungus and insects. It is sometimes attacked by a heart rot or red rot and is sometimes affected by sun scald. It sprouts rather poorly.

The compound leaves are tufted at the ends of the branchlets. In the autumn they turn a brownish purple, fading to yellow.

The short leaf period and soil requirements count against this tree for shade purposes, although it makes a beautiful and hardy species.

CATALPA.

Catalpa catalpa.

(Other common name — Indian bean.)

This tree is commonly found in southeastern United States.

The bark is brown and tinged with red, broken on the surface into thin scales. It reaches a height of about 50 feet and a diameter of about 4 feet. The branches are long and heavy, forming a broad round-topped head.

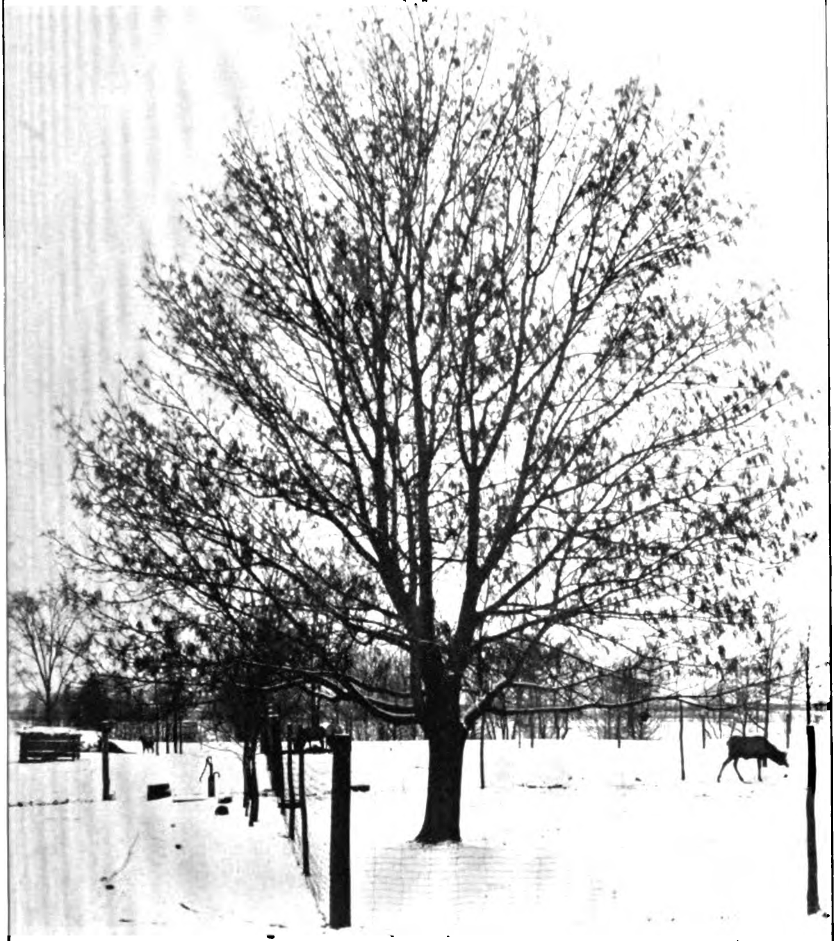
This species is more showy and decorative than the hardy catalpa (catalpa speciosa), although it is a much poorer tree from a commerciful standpoint. This and the horse chestnut are probably the most showy of our decorative trees. It blooms quite late. The flowers are large white panicles, 8 to 10 inches long. The leaves appear rather late. They are large and heart shaped. At the first frost they turn dark and fall.

The tree is easily handled in planting and is nearly free from insects and fungi. The falling of the flowers, leaves and fruit makes the tree rather uncleanly. It is moderately rapid in growth and will persist on most soils unless too dry.

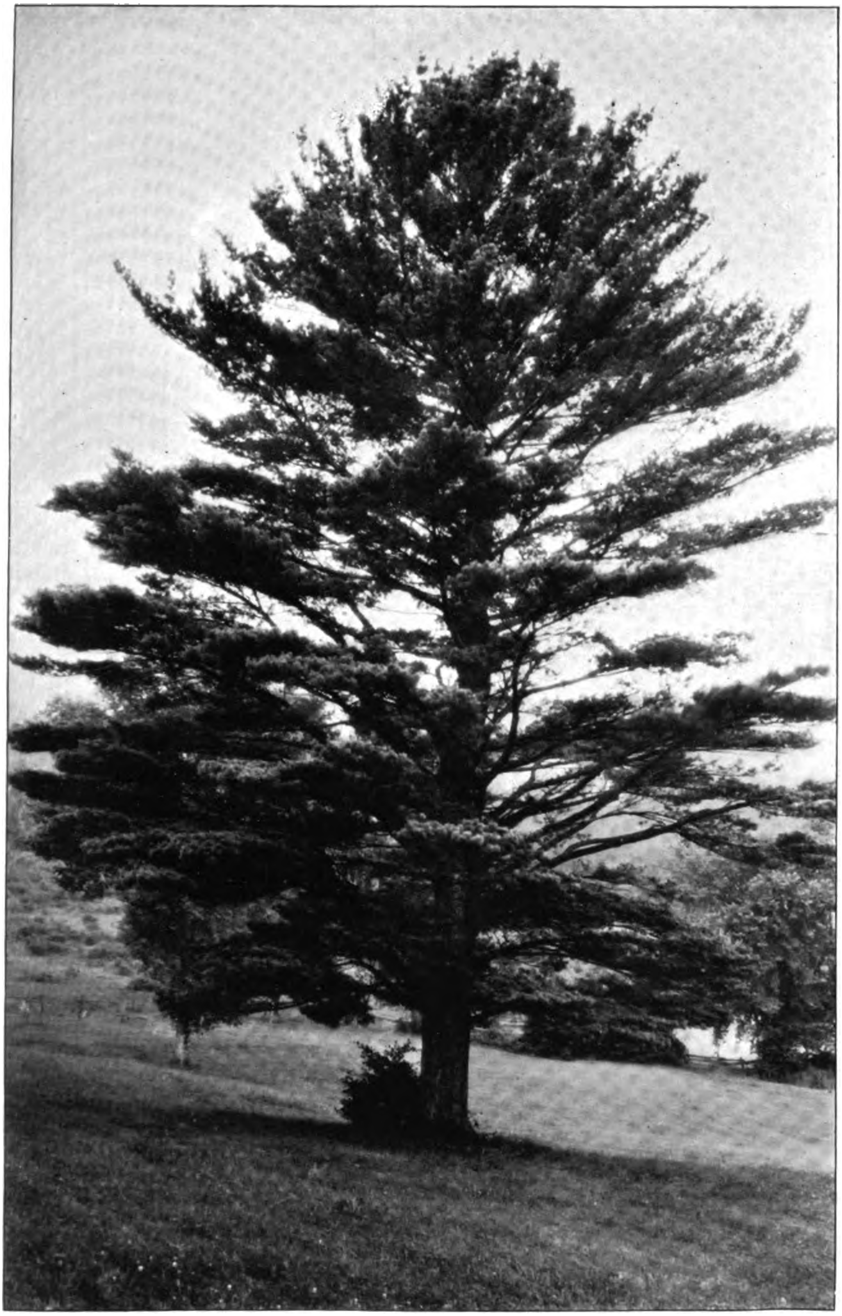
The fact of its having showy flowers is likely to cause its mutilation if it stands in any public place. It would do better planted in open yards than on the curb line.

CONIFERS

The following conifers are placed in this list, not for their value as street trees, but for their value as ornamental trees for landscape or lawn work. In a pamphlet on shade trees, there is really no reason why the discussion should stop at the curb. If it is necessary for the public to know what to plant along the street, it is practically as necessary to discuss what shall be planted, say, 100 feet back from the street.



White ash



White pine

WHITE PINE.

Pinus strobus.

(Other common name — soft pine.)

This tree is found in the eastern forest area from Canada south to Georgia.

The bark is divided by shallow fissures into broad connected ridges. It grows to be 100 feet or more high, and 3 to 4 feet in diameter. The stem is straight. The branches are slightly ascending, forming a conical crown when young and a broad flattened one in old age. The needles are a beautiful dark green and have a softer look than those of most other pines. After the first three or four years the growth is rapid.

The white pine will grow under a variety of soil and moisture conditions. It makes its best growth on a fresh sandy loam. It will grow on a clay or lime soil. The tree develops a long deep tap root and many long spreading laterals. It is fairly tolerant of shade and is wind firm. It is easy to transplant. The white pine weevil is the most serious insect enemy of this tree, as it kills the leader and thereby deforms the tree.

This is one of the best conifers to plant for ornamental purposes and is about the only pine which could possibly be used for street planting.

NORWAY PINE.

Pinus resinosa.

(Other common names — red pine, hard pine.)

This tree is found in northern United States from Massachusetts to Minnesota.

It is the best tree for ornamental purposes of the northern hard or pitch pines. The bark is a red brown and divided into ridges. The tree is usually less than 100 feet high and 2 to 3 feet in diameter. The branches are thick and more or less pendulous, forming a broad irregular pyramid, reaching nearly to the ground. In old age the crown opens up and forms a round picturesque head. The roots are somewhat deeper than those of the white pine, but the tree is easy to handle.

This pine naturally grows on a much poorer soil than the white pine and will stand drought exceedingly well. The growth is fairly rapid and it lives to be 250 years old. The tree is very intolerant and must have full light from the start. There is not much insect or fungous damage until after maturity.

The leaves of this pine are longer and coarser than the white pine. They are covered with a pale bloom. In the early spring the staminate blossom is a deep red rose color.

This is a very good tree to plant in open places for landscape effects.

TAMARACK.

Larix americana.

(Other common name — larch.)

This is the only deciduous conifer which we have naturally in northeastern United States. In the fall the leaves turn a golden yellow. The tree grows to be 50 or 60 feet high and 18 to 20 inches in diameter. The branches are small and horizontal, forming in early life a narrow regular pyramid, and at old age sweeping into graceful curves, often pendulous, forming a broad open head. The roots are shallow and spreading. The growth is rapid and the tree lives to be 125 years old.

This is a very intolerant swamp tree, and, therefore, requires plenty of moisture and light. The tree is much troubled by the larch saw fly. It should be planted only in landscape work and should not be used as an individual tree near buildings.

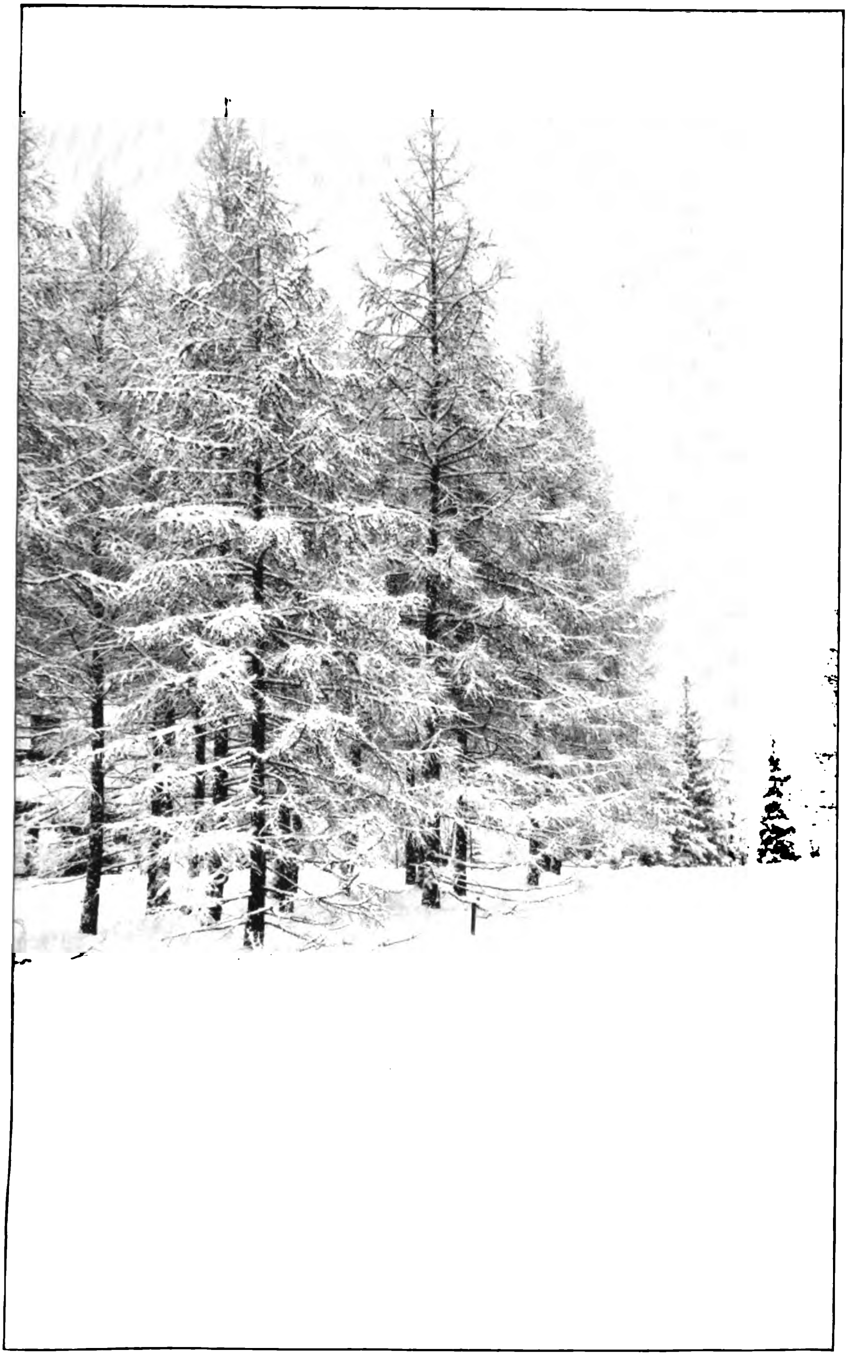
NORWAY SPRUCE.

Picea excelsa.

This tree was imported from Europe. If spruce is desired anywhere except on swampy land, this is the species to be planted, as it is the most graceful and the fastest grower. If the locality to be planted is very swampy, the black spruce is better adapted, but it is of slow growth. The outline of the Norway spruce is very graceful and symmetrical. The branches sweep downward with a graceful curve and the branchlets are pendulous. The foliage is a dark green.

The tree grows in many forms and care should be taken to select the weeping variety, if it is to be used as an individual tree. This species may also be used in hedges, as it stands pruning and shade quite well. It is easily handled in the nursery and is comparatively free from insects and fungus.

The Colorado blue spruce is much used for decorative planting. Its value lies in the decidedly blue color of its foliage.



European larch

HEMLOCK.

Tsuga canadensis.

(Other common name — hemlock spruce.)

Found from Nova Scotia and Minnesota south to Georgia. It is usually 60 to 70 feet high and 2 to 4 feet in diameter. The branches are pendulous and form a broad-based, rather obtuse cone, which tapers conspicuously toward the apex. The foliage is dense and dark green. The growth is slow but the tree very long lived, oftentimes living 600 years. It grows on many soils from swamps to barren slopes, but it does best on a moist clay soil. It is very tolerant of shade. It is not much injured by insects, but fungi cause a great deal of damage. It can be used for hedges and can be planted as an individual or in groups for landscape work.

BALSAM.

Abies balsamea.

(Other common names — fir, balsam fir, balm of Gilead.)

In the United States this tree extends from Canada south along the Appalachian Mountains to Virginia. It gets to be 50 to 60 feet high and 12 to 18 inches in diameter. The spreading symmetrical branches form a perfect cone, reaching to the ground. At maturity the lower branches die out and the crown becomes narrow and dense. The root system is very shallow. It is a very tolerant shade tree. Its growth is rapid, but it is short lived. It demands a wet soil. It is easily wind thrown and is much troubled by fungi.

The silver fir of Europe surpasses the native fir in ornamental value and should be used in preference.

WHITE CEDAR.

Thuja occidentalis.

(Other common names — arbor vitæ, cedar.)

The white cedar is found from Massachusetts to Michigan and south along the mountains to Tennessee. It grows to be 50 or 60 feet high and 2 to 3 feet in diameter, although sometimes the diameter reaches 6 feet. The trunk is buttressed and often divides into two or more stout secondary stems. Stout horizontal branches, soon turning upward, form a narrow compact conical head. It must have an abundance of moisture for successful growth although it is not particular as to the character of the soil. Its growth is rapid at first, but slows down after a few years. It is liable to decay in the butt. It is fairly tolerant of shade and will do for hedges. It is easily handled in planting.

RED CEDAR.

Juniperus virginiana.

(Other common names — juniper, red juniper, savin.)

This tree is found from New England to Dakota and south to Virginia and Texas. It gets to be 50 to 60 feet high and 3 to 4 feet in diameter. The branches are slender and horizontal on the lower part of the tree, erect above, forming a narrow, compact conical head, which changes at maturity into a shorter and rounder head.

The tree will grow on very poor dry soil, but it is then of very slow growth. Even on the best situations its growth is quite slow. Its butt is usually affected with heart rot but it is free from insects. The foliage is oftentimes a dingy brown in winter.

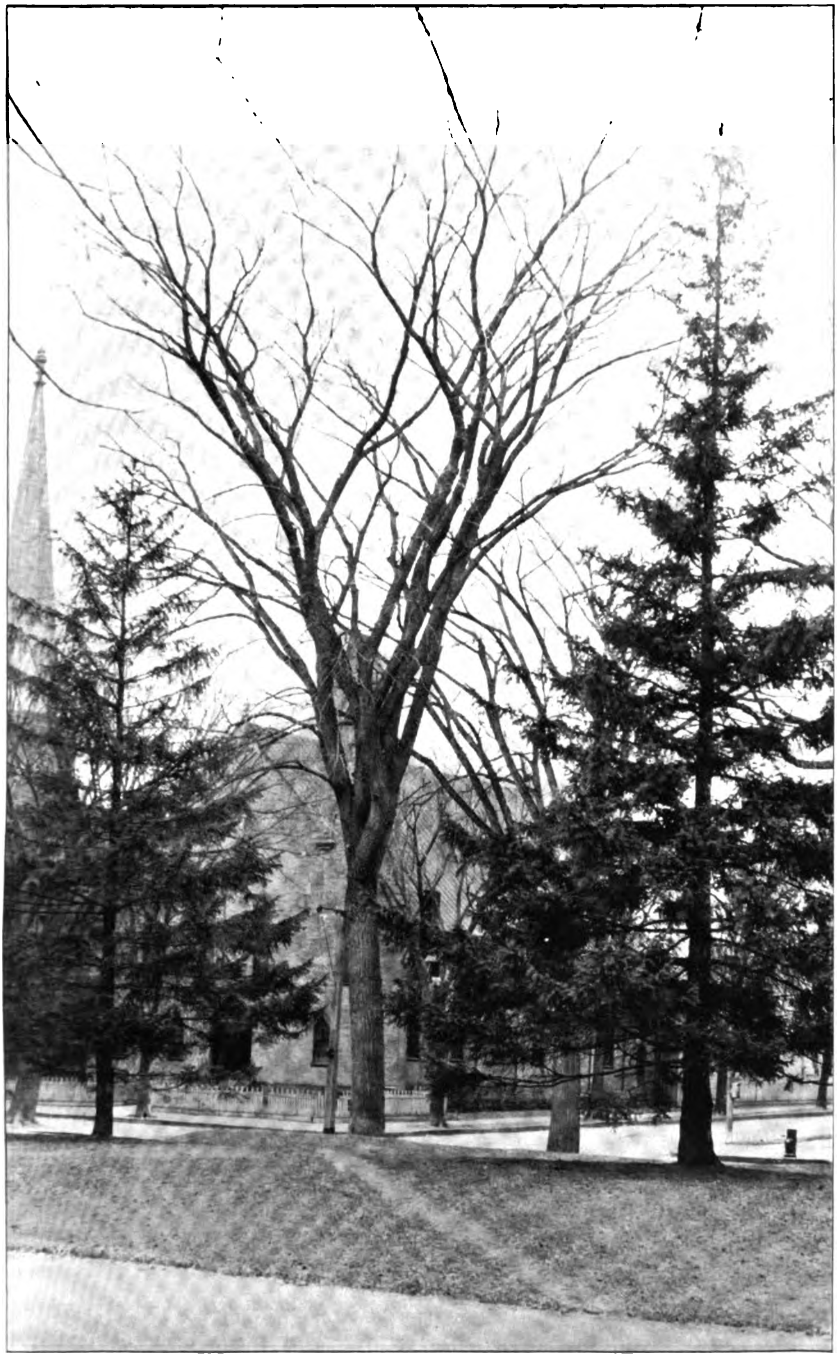
This tree would be well suited to plant on poor, open soils with the pines. It will not do for hedges.

GINKGO.

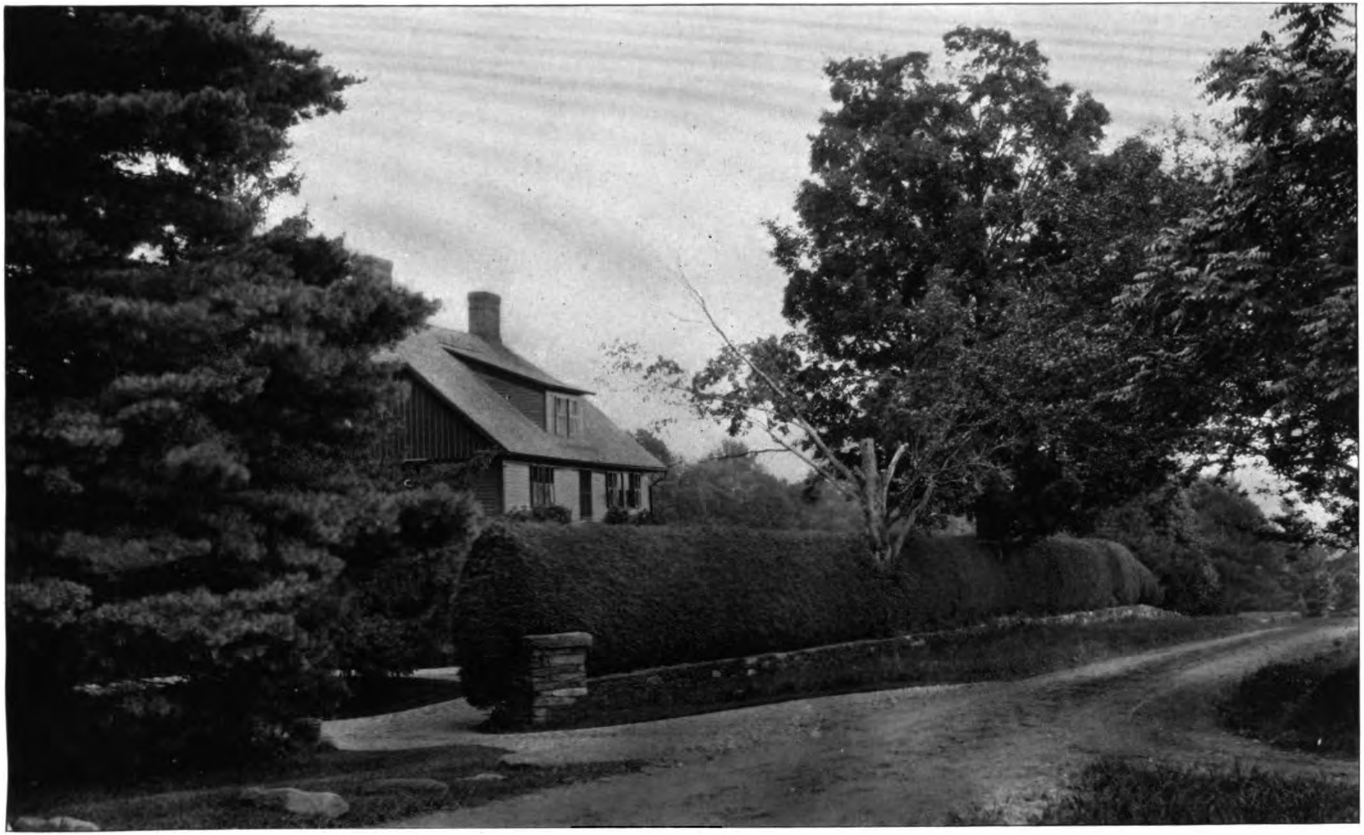
Ginkgo biloba.

This tree was first imported from China. The leaves of the Ginkgo resemble those of the maidenhair fern. They fall in the autumn after turning yellow. The tree is of medium size and the young trees are tall, slender and spire-like, with a tendency for the branches to hug the stem, while at maturity they spread out, giving the tree a straggling look. It is a rapid grower and is absolutely free from insects.

It is not a good street tree, but is best planted singly for landscape work.



Norway spruce and American elm



Hemlock hedge

TABULATION OF SHADE TREE CHARACTERISTICS.

The following table will show at a glance the main characteristics of the trees discussed.

We must remember that in a table of this kind, only generalizations can be made use of and many of the figures depend directly on the conditions under which the tree is grown.

The height of a tree depends directly on the soil, moisture and surrounding trees. The growth is dependent on the richness of the soil and the amount of moisture, as all trees will grow more rapidly on a good soil than on a poor one, the only difference being that some trees will grow better than others on a poor soil. The age limit depends on the normality of conditions. The tolerance varies greatly with the age of the tree. In practically all cases young trees are more tolerant than old ones.

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Th ing	Valuable features	Disagreeable features	
Qu	Massive form, fruit	Leaf period short.	1.
	None	" " "	2.
	Shaggy bark, fruit	Litter at fruiting.	3.
			4.
			5.
Ve	Trembling leaves, green bark.	Short life, fungous troubles.	6.
			7.
Qu	Glossy foliage, stands abuse	Cottony seeds.	8.
	Spire like form	Short life, irregular death.	9.
Ra	Golden color of twigs		10.
	Weeping character	Suckering.	11.
Qu	Pendulous fruit.		12.
Ve	Muscled stem, stands pruning.		13.
To	White bark	Low branching.	14.
	Curly bark	" "	15.
In		Short life.	16.
Qu			17.
Ve	Winter appearance.		18.
Qu	Rapid growth	Chestnut blight.†	19.
Ra	Hardiness, long life.		20.
	Ability to grow on poor soil.		21.

PART II.

CARE OF THE TREE.

Planting

We must be certain, first of all, in planting our shade trees, that those selected are adapted to the soil where the planting is to be done.

The best time to plant trees is just as soon as the frost gets out of the ground in the spring; that is, just before the sap begins to flow. The next best time is after the leaves have fallen in late autumn. This time of planting is to be preferred for certain species. A tree should never be planted in midsummer if it is possible to avoid it.

In transplanting a tree, the roots should be kept as nearly normal as possible. As much of the root system as can be should be dug up with it, and whenever it is possible a ball of earth should be taken up with it to prevent the delicate root hairs from drying out. If no earth can be taken up with the tree, great care should be used to protect the roots from the drying action of the sun and air. It is well to cover the roots with burlap or damp straw.

The tree is usually of such a size that the larger roots have to be cut. Care should be taken to trim the ragged ends of these roots by a good clean bevel cut, the cut surface down. If this is done, the ragged end will not decay and it will sprout much more easily.

The hole which is made to receive the tree should be large enough to take care of the roots without crowding. In case much of the root system is lost in transplanting, the limbs of the tree should be cut back, the amount depending on the roots lost. It would be well to cut all trees back somewhat, otherwise they are liable to dry out. This is particularly true of trees which have been growing under favorable soil and atmospheric moisture conditions.

Fertilizing the tree is not as essential in the country as it is in the city. In the city the soil is often "made soil" or a deep soil, in which case it would be well to dig a hole much deeper than is needed for the tree and to partially refill it with rich loam and some well-rotted manure. It is well to water the tree after planting, and to do so at various intervals until it is apparent that it has made a good start.

The tree should be spaced according to the size of the crown which it will later develop. Fifty to 100 feet is the usual spacing for broad-leaved species. Such trees as the elm and the sycamore should be given the wider spacing, while most other trees require 50 to 75 feet. The tree should be set in the earth at its original level and the soil packed well around the roots. In the case of a small tree, it is well to drive one or two strong stakes in the ground beside it and securely fasten it to these stakes. Care must be taken in making these fastenings that they will not injure the tree when it is worked by the wind.

Our battle for shade has only just commenced when we have the tree in the ground. We must watch it continually, and protect is not only from fungi and insects, but from man and beast.

PROTECTION OF THE TREE.

PROTECTION FROM FUNGI.

After maturity, practically all trees suffer from fungous troubles, commonly called rot. Different kinds of fungi attack all parts of the tree, leaves, bark, wood and roots.

To protect from fungous growth, the first problem is to protect the tree from injury, as it is through wounds to the tree that the parasites gain access to the living tissue. A perfectly healthy, vigorous tree does not suffer from fungous trouble except in rare instances. If the tree is injured in any way, a trimming of the torn parts and the immediate application of tar or heavy paint is the most efficient protection.

Careless pruning does a great deal to shorten the life of trees. If it is done carelessly, it leaves rotten stubs or torn places, which serve as the starting points for disease. Care should be taken to properly trim out all dead branches and to anticipate such branches, if possible, and trim them out before entirely dead. More will be said on this subject under "Tree Surgery."

If the tree in question is growing stag headed or seems to be dying back in any way, it is probable that it cannot sufficiently nourish or care for such an expanse of leaf surface and a heavy pruning may give the remaining limbs force enough to withstand the attacks of fungi for some little time.

When the leaves are attacked by fungi, it appears sometimes by causing them to shrivel and drop off, or it may appear as small discolored spots, which later dry and break out, leaving the leaf full of holes. In the case of leaf fungi, the damage is not very great, as the leaves of practically all broad leaved trees and some conifers are shed in the fall and a new infection must be made the following spring, if the damage is to continue.

Some fungi attack the twigs and branches. Others attack the sap-wood and still others the heart wood. When fungous growth is found in the larger parts of the tree, if it is discovered before it has too strong a hold, it can sometimes be held in check by cutting out the diseased part and keeping close watch for future signs. Oftentimes, though, when we are aware that a tree is diseased, it is too late to do anything, as the fine myeelia have pierced so far into the tree structure that we can do nothing to rid the tree of this pest, and it is simply the beginning of the end. Thus we cannot place too much emphasis on allowing no openings for the entrance of disease.

Some fungi, particularly those known as the rusts, at different stages of their lives live on different plants. The fungus known as the cedar apple, a disease on the red cedar, lives during one period of its life on the apple tree. If we desire to rid either the cedar or the apple tree of this disease, we can do so by destroying all of the other species which are within range of the spores.

A good example of the above occurs in the present fight of New York and other States against the blister rust of the white pine, which has been imported from Europe on nursery stock. The genus ribes (currant) acts as host to this fungus at one stage of its life history. The State annually inspects all plantations of this diseased stock and destroys the diseased plants. It also very carefully inspects the territory within 500 feet of any planting and destroys all species of ribes found within this territory, thus destroying the disease by taking away one of its hosts.

In the case of fungous attacks to a tree, the only remedy is in the nature of a fungicide, which is sprayed or painted on. The best fungicide is known as the Bordeaux mixture, which, according to the formula in Fernow's "Care of the Trees," is as follows:

5 lbs. of copper sulphate ($CuSO_4$) dissolved in hot water
5 lbs. of fresh quicklime, freshly and slowly slaked

The quicklime should be passed through a fine wire strainer and diluted by gradually adding a gallon of water. It must be in the form of a creamy liquid, free from grit. The two liquid mixtures are now diluted with 24 gallons of water each and slowly mixed by pouring simultaneously into a 50 gallon cask (no metal vessels can be used).

If an insecticide is also wanted, add 5 ounces of paris green.

In general, then, to protect our trees from the attacks of fungi, we must use preventive measures, by keeping the tree free from dead parts and exposed wounds, and if fungi gain a foothold, remove the diseased portions as well as possible and then, by the frequent use of the Bordeaux mixture, keep the infection under control.

The following works are given as reference to those who desire to go into this investigation more fully:

Fungous Diseases of Forest Trees. Reprint from Year Book of the Department of Agriculture, 1900.

Diseases of Ornamental Trees. Reprint from Year Book of the Department of Agriculture, 1907.

Self Boiled Lime Sulphate Mixture as a Promising Fungicide. Bureau of Plant Industry, Circular 1.

Care of the Trees, By B. E. Fernow. Published by Henry Holt & Co., New York.

The Diseases of Trees, by Hartig. Published by McMillan & Co., New York.

Shade Trees in Towns and Cities, by W. Solotaroff. Published by John Wiley & Sons, New York.

The Conservation Commission has recently appointed a forest pathologist who is available to give scientific advice on the subject of tree diseases.

PROTECTION FROM INSECTS.

The scope of this bulletin will not permit taking up in detail the various insects which are injurious to trees. An attempt has been made to describe the different workings of insects and various remedies are suggested.

The question of protecting our shade trees from insects is getting to be an exceedingly important one, as there are many insects which are doing great damage. There is a likelihood that the number of highly destructive insects will be added to at any time by the importations of foreign species from Europe and Asia. Massachusetts and the United States government have spent many thousands of dollars trying to get the gypsy and brown-tail moths under control, and yet these moths are spreading over more and more territory every year. Both of these moths came from Europe.

The insects doing damage to trees can be divided into three general classes: Biting insects, sucking insects and wood-boring insects. The biting or leaf-eating insects are those that do the greatest damage to shade trees and are the easiest to handle, as at no period in their growth, except in a few cases, are they where man cannot get at them.

The life of insects has four distinct stages: First, the egg; second, the grub or larva; third, the dormant cocoon stage; fourth, the moth or beetle stage. Most insects can be successfully fought during the first or second stages, or both.

Biting Insects.

Under biting insects we place all those insects which devour the leaves. These insects can be easily discovered in the second stage of their growth from the partially eaten leaves on the tree. There is no set time when these evidences appear, as some species hatch out later than others and some have two or three broods in a single season, while others have only one.

As soon as it is evident that insects are at work on the foliage, the tree should be sprayed with a solution of paris green or arsenate of lead (formulæ given later). The work of spraying must be carefully and thoroughly done, as a careless spraying is little better than none. Care must be taken to spray the side of the leaf that the insects are working on, usually the under side. Inasmuch as the caterpillars do not eat the poisoned parts until driven to it, a complete spraying should be accomplished.

Some kinds of insects lay their eggs in certain definite places and it is oftentimes possible to attack the insects at this stage by creosoting the egg masses. A great many insects lay their eggs in the refuse on the ground and the burning of this refuse will accomplish much good. Stone walls and rail fences are also favorite places for the eggs of some species and these should be carefully inspected.

The third stage, when the insect is in the cocoon, also often gives a chance for destruction. Such insects as the fall web worm and the brown-tail moth make very noticeable nests at some season of the year. These nests can be cut off and destroyed.

With insects like the elm leaf beetle the egg is hatched on the ground and the caterpillar must crawl up the tree to its food supply. In such cases a band of cotton batting, tree tanglefoot or tarred paper is very efficient. The caterpillars collecting below this band should be gathered and destroyed from time to time.

Thus it is the duty of the owner of trees to determine the character of the workings of the insect and decide on the proper means of control.

Sucking Insects.

These insects consist of the bark lice and scale insects. The most efficient protection from such insects is a careful spraying with kerosene emulsion. In using the emulsion on a young tree, care must be taken not to put on so much that it soaks the ground beneath the tree, else the roots may be smothered. Whitewashing the tree undoubtedly does much good, not by killing the insects but in keeping them away. A solution of tobacco or lime and sulphur is often used to rid the trees of these pests.

Boring Insects.

These insects consist of round and flat-headed borers, bark beetles, etc. They are very hard to deal with, as practically all of their life is spent in the tree and they cannot be exposed without killing the tree. In the case of some borers, the egg is laid on the bark, and on hatching, the grub starts boring for the woody parts. In the case of such insects, a spraying of kerosene emulsion is very good.

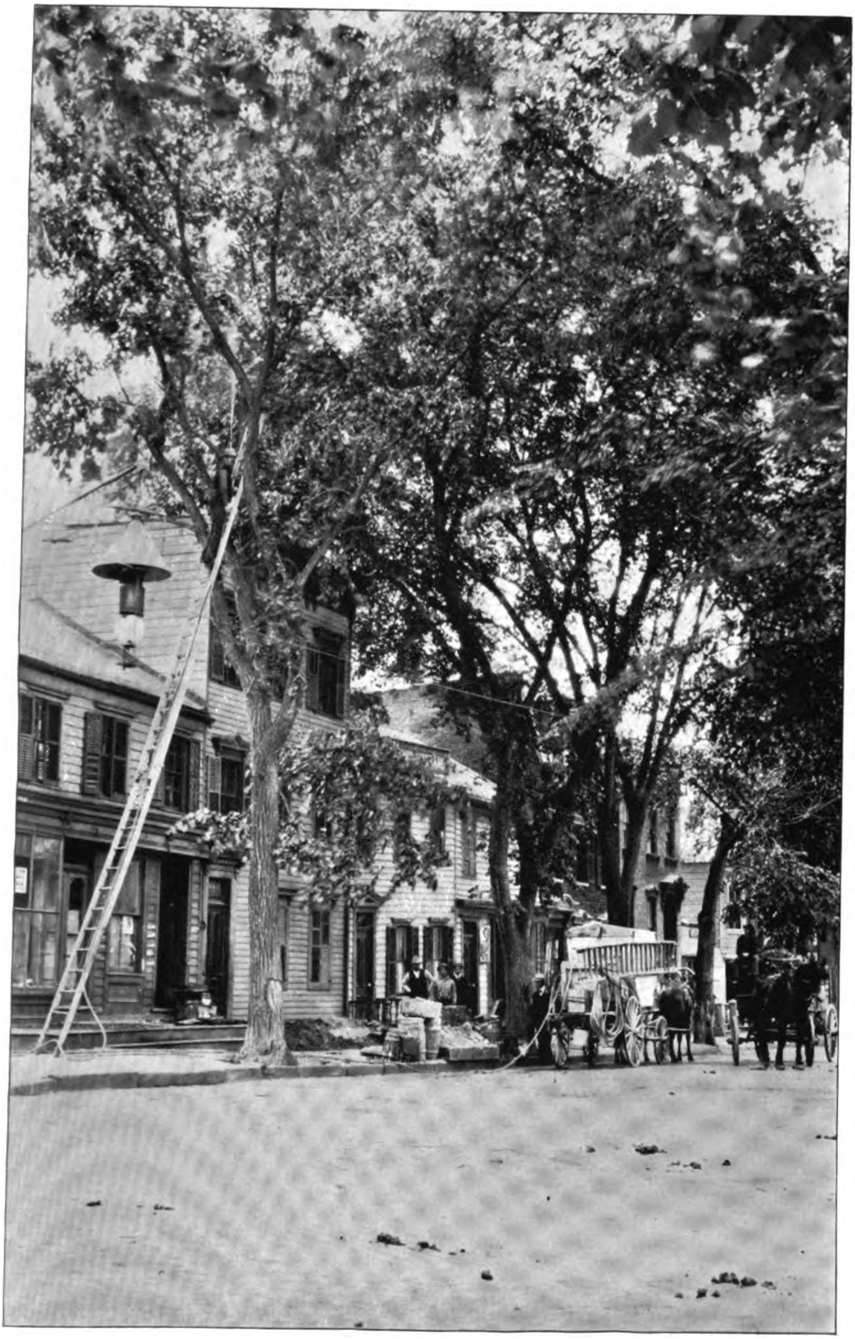
Borers show where they are working by small piles of sawdust. From this sawdust the hole may be found and by injecting carbon bisulphide into such a hole and then plugging it with grafting wax or hard soap, the insect will be killed. Such treatment is well worth while in the case of the maple borer, where three or four insects may practically ruin the tree.

The bark beetles are the hardest to attack and often do a great amount of damage. They do not usually attack any but weakened trees. When bark beetles are found on a tree, about the only thing to do is to cut them out.

Formulæ for Insecticides.

Paris Green Solution.

1 lb. of paris green with 100 to 300 gallons of water. The strength of this solution depends on the insects to be fought. The elm leaf beetle takes the strongest solution. 1 lb. of milk of lime may be added to prevent injury to the foliage.



Tree Spraying Apparatus

Arsenate of Lead Solution.

5 lbs. of arsenate of lead to barrel of water is the usual strength. For brown-tail moths, 10 lbs. to 100 gallons should be used.

Lime Sulphur Wash.

40 lbs. of lime, 20 lbs. of sulphur, 15 lbs. of ordinary salt, 60 gals. of water. Lime added to a little hot water, as soon as slaking commences add sulphur and boil 30 minutes, stirring constantly.

Creosote Mixture.

5 pints of creosote, 2 pints carbolic acid, 2 pints turpentine, 1 pint crude coal tar.

Kerosene Emulsion.

½ lb. whale oil soap to 1 gal. boiling water and added, while still boiling hot, 2 gals. of kerosene. The mixture should be stirred until it has the consistency of cream, when it is diluted by adding 15 to 20 parts of water for soft bodied insects and 7 to 9 parts for hard bodied insects.

Tobacco Solution.

1 lb. of tobacco steeped for two to three hours in 1 gal. of water and then diluted with 3 to 4 parts of water.

Carbon Bisulphide Solution.

This can be purchased in any drug store, as it is a common stock chemical.

Common Enemies of Shade Trees.

The following is a list of some of the common enemies of shade trees:

Hickory and Walnut.........	White-marked tussock moth Hickory horned devil Fall web worm Cecropia moth Round-headed borer Flat-headed hickory borer Hickory bark beetle Gypsy moth Painted hickory borer Brown-tail moth Imperial moth Walnut sphinx

	Hickory twig girdler
	Hickory bark weevil
Birch	Flat-headed borer
	Saw-fly
Oak	Io moth
	Round-headed borer
	Flat-headed borer
	Oak web worm
	Oak timber worm
	Spiny oak worm
	Imperial moth
	Brown-tail moth
	Gypsy moth
	Luna moth
	Bark beetles
	Two-lined chestnut borer
	Carpenter worm
Chestnut	Timber worm
	Two-lined chestnut borer
	Brown-tail moth
	Gypsy moth
Elm	Elm leaf beetle
	White-marked tussock moth
	Fall web worm
	Io moth
	White-lined sphinx
	Elm tree borer
	Gypsy moth
	Four-horned sphinx
Tulip	Promethia moth
Poplar, Willows and Linden	Flat-headed borers
	Round-headed borers
	Luna silk moth
	Bag worm
	Gypsy moth
	Willow weevil

	Linden borer
	Large American saw-fly
	San Jose scale
	Oyster shell scale
Locust	Locust borer
	Carpenter worm
	Locust leaf folder
Ailanthus	Ailanthus moth
Sassafras	Promethia silk worm
Ash	Ash tree bark beetle
	Wavy ash sphinx
	Oyster shell scale
Catalpa	Catalpa sphinx
Maple	Gypsy moth
	Brown-tail moth
	White-marked tussock moth
	Sugar maple borer
	Maple leaf scale
	Leopard moth
	Horn-tailed wasp
	Flat-headed borer
	Green-striped maple worm
	Imperial moth
	Tent caterpillar
	Carpenter worm
Pine	Pine weevil
	Pine saw-fly
	Pine leaf scale
	White pine sawyer
	Bark beetles
	Flat-headed borer
	Round-headed borer
	Imperial moth
	Ambrosia beetle

Spruce and Fir	Pine sawyer
	Bark beetles
	Spruce gaul aphis
	Round-headed borer
	Flat-headed borer
Cedar and Cypress	Cedar bark beetle
	Bag worm
Larch	Larch saw-fly

References on Insect Damage.

Care of the Trees, by B. E. Fernow. Henry Holt & Co., New York.

Shade Trees in Towns and Cities, by W. Solotaroff. Published by John Wiley & Sons, New York.

Shade Tree Pests. Bulletin of the New York State Museum, Vol. 6, No. 27. Price 5 cents.

Scale Insects of Importance. Bulletin New York State Museum, Vol. 9, No. 46. Price 25 cents.

White Marked Tussock Moth and the Elm Leaf Beetle. Bulletin New York State Museum, Bulletin 109, Department of Entomology, No. 27. Price 20 cents.

Gypsy and Brown-Tail Moths. New York State Museum, Bulletin 103, Department of Entomology, No. 25. Price 15 cents.

Some of the Principal Insect Enemies of Coniferous Forests in the United States. Reprint from Year Book, Department of Agriculture, 1902.

The Catalpa Sphinx. U. S. Dept. of Agriculture, Bureau of Entomology, Circular 96.

The Imported Elm Leaf Beetle. U. S. Dept. of Agriculture, Bureau of Entomology, Circular 8, 2d Series.

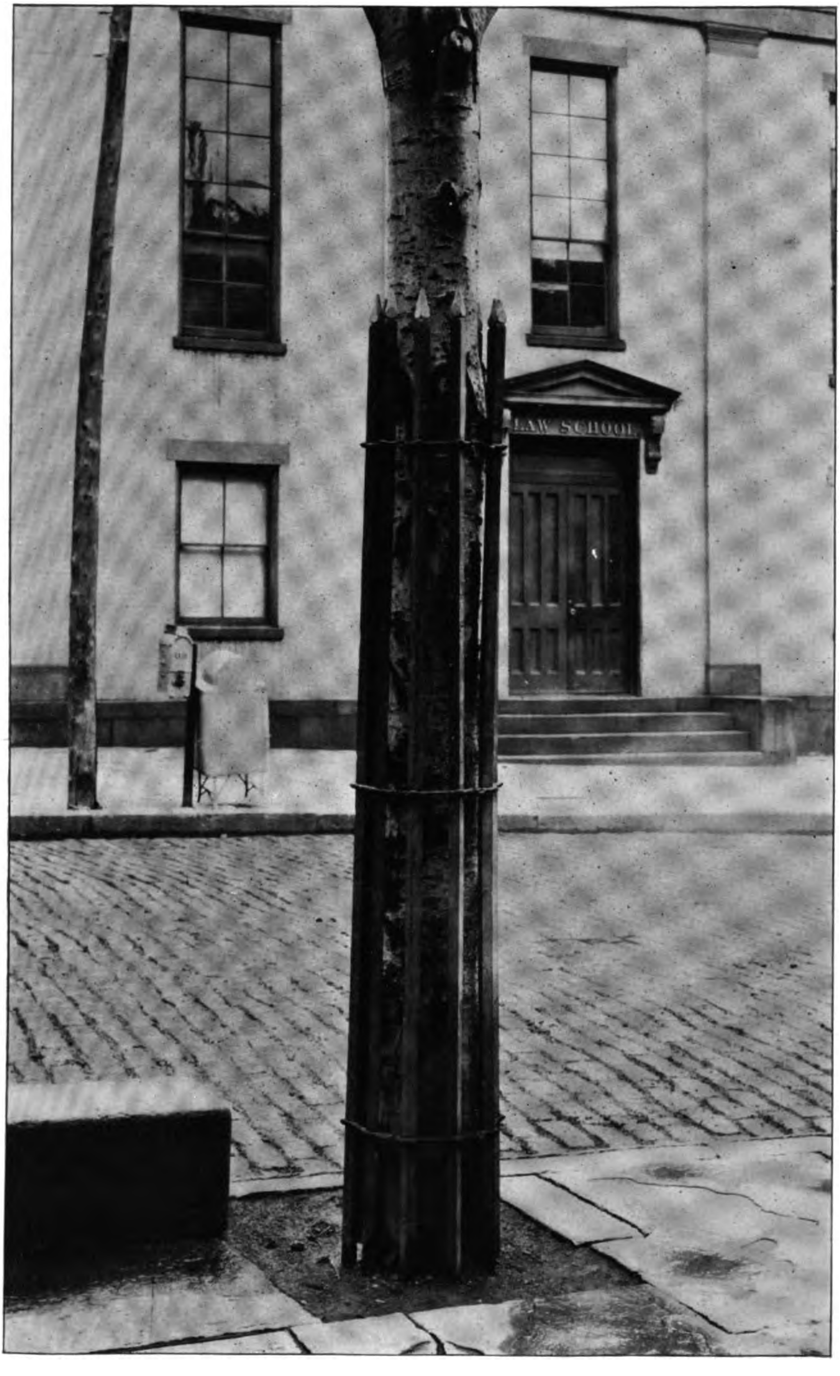
The White Pine Weevil. U. S. Dept. of Agriculture, Bureau of Entomology, Circular 90.

The Imported Elm Leaf Beetle. U. S. Dept. of Agriculture, Bureau of Entomology, Bulletin 6, 2d edition.

The Life History of Two Species of Plant Lice. U. S. Dept. of Agriculture, Bureau of Entomology, Bulletin 9, Technical Series.

The San Jose Scale. U. S. Dept. of Agriculture, Bureau of Entomology, Bulletin 3, New Series.

Some Insects Injurious to Forests. U. S. Dept. of Agriculture, Bureau of Entomology, Bulletin 58, Parts 1 and 3.



Tree well boxed

The Locust Borer and Methods for Its Control. U. S. Dept. of Agriculture, Bureau of Entomology, Circular 83.

The Two-Lined Chestnut Borer. U. S. Dept. of Agriculture, Bureau of Entomology, Circular 24.

The Brown-tail Moth. U. S. Dept. of Agriculture, Farmers' Bulletin No. 264.

Gypsy Moth. U. S. Dept. of Agriculture, Farmers' Bulletin No. 275.

Three Insect Enemies of Shade Trees (elm leaf beetle, white-marked tussock moth, and fall web worm). U. S. Dept. of Agriculture, Farmers' Bulletin No. 99.

Insects Injurious to Hardwood Forest Trees. Reprint from Year Book, Dept. of Agriculture, 1903.

The Bag Worm. U. S. Dept. of Agriculture, Bureau of Entomology, Circular 97.

The Leopard Moth. U. S. Dept. of Agriculture, Bureau of Entomology, Circular 109.

PROTECTION FROM WEATHER ACTIONS.

Trees are often killed or badly injured in the natural course of events. Very severe winters have killed species that are considered hardy. Frost often causes what is known as frost cracks, which appear as longitudinal cracks in the tree trunk and are often of large size. A tree which has been used to shade is subject to sun scald if that shade is suddenly removed. This appears as a drying or shriveling of the bark on the sunny side. The species having tender bark, such as the poplars, willows, etc., are especially subject to this damage. There is much breakage of limbs and branches, due to snow, sleet and wind.

Trees are not usually killed by the cold unless we have a very severe winter with little snow. Under such conditions valuable trees might be protected by a layer of straw or a mulch placed over the root system. Little can be done to prevent frost cracks. Such damage usually occurs in low swamps or pot holes and there is little of a practical nature that can be accomplished to prevent it.

To prevent sun scald we must be careful in removing the shade from about tender-barked species. The shade must be removed gradually, in order that the tree may be toughened before the final exposure.

Snow, sleet and wind breakage can best be avoided by judicious pruning, thus decreasing the exposed surface.

PROTECTION FROM MAN.

It does not seem as though we should need to protect street trees from the very beings to whom they are supposed to bring pleasure, and yet such protection is quite necessary.

Man injures trees indirectly by the digging of sewers and ditches, the leaking of gas mains, the careless stringing of electric wires, grading of streets, laying of sidewalks, careless hitching of horses, etc.

Injury from Gas.

In many parts of the country, where the smelting of ores containing sulphur is going on, trees are killed at great distances from the smelters because of the excess of sulphur dioxide in the atmosphere. In New York State this phase is not of great importance. Gases of a poisonous nature are not usually present in the atmosphere in large enough quantities to cause death. The death of trees growing near railroad yards where there is a constant use of locomotives is oftentimes undoubtedly due to the fumes from the engines.

The principal cause for complaint against gas injury comes from the leakage of gas from the mains which are laid under the streets. When there is a slight leakage in a main, it is oftentimes impossible to detect it and the air in the soil is slowly replaced by gas, which serves to strangle the tree. Such damage is made known to us in different ways. If the leak is sudden and of some extent, the tree dies as a whole and the leaves dry up, but remain hanging on the tree. If the leak is small and slow, there may be a partial drying of the leaves. The edges may turn brown or individual leaves die as a whole. The roots are discolored, appearing blue, and the sap-wood is in the same condition. A tree badly affected is lost, but if gas poisoning is detected in time, the branches and roots can be pruned back and the soil replaced by fresh soil with some hope of recovery.

Gas poisoning is much more frequent than might be supposed, as it is figured by some companies that as high as 10 per cent. of the gas manufactured is lost by leakage.

Injury from Electricity.

Under this heading it is well to discuss the damage done in stringing electric wires. Unless the workmen are closely watched, they are very apt to cut through the tree-tops indiscriminately, and absolutely ruin the looks of whole rows of trees. The first safeguard then is to see that the wires are strung in the proper place and then to see that the wires of high voltage are protected so that in any possible rubbing on the limbs of the tree, the live wire will be insulated from the bark.

Wires of heavy voltage are usually covered in the regular way, but this is not sufficient, as it will soon wear through, if continually rubbed by a branch. Pieces of wood may be fastened around the main wire in such a way that the wear will come on these pieces. If wires do come in contact with the tree enough to cause injury, the effect is much the same as if the tree were killed by gas. The foliage dries and remains on the tree. The trouble is usually caused in wet weather, when the current short circuits and burns the limb so that it dies out above the wound.

Nature also takes a hand in electrical injury when lightning strikes a tree. Trees are often completely torn to pieces by lightning. If not really broken up, they are often girdled and killed by a spiral strip being torn out.

Injury from Horses.

Very little need be said about this kind of injury, as it is very familiar to all of us. The proper kinds of hitching posts should be set wherever there is any likelihood of injury to trees, and horses should be hitched at such posts and never to trees. By stripping the bark, horses partially girdle the tree and thus weaken it and make it more prone to the attacks of fungi and insects. The damage itself is very unsightly. It is one of the easiest injuries to stop and yet it is one of the most common. A very efficient protection against this kind of injury is the common practice of caging the tree. A simple woven wire makes the cheapest kind of cage and it may vary from this form to an expensive bent iron box.

Injuries from Digging of Trenches, Laying of Sidewalks, Grades, etc.

A great deal of unnecessary damage is done to shade trees in tearing up the streets. In digging trenches, it is the usual custom to cut all roots. This is not at all necessary and all roots above an inch or two in diameter should be dug around wherever possible, and care should be used not to injure them by unnecessary bruising. Where ditches are dug close to the side of the road, it often happens that a third of the root system is taken from the tree.

The laying of sidewalks is even a worse cause of trouble, as it is done much closer to the tree. If the grade is lowered at all, it means cutting away all the roots which interfere. The walk could oftentimes be curved out around trees in such a way that they would be little injured. On the other hand, it is not necessary to give the sidewalk the same grade as the road. Some very beautiful effects can be had where there is more or less of an embankment from the walk to the street.

Where the grade of a street is changed, the trees are the worst sufferers. If the grade is cut and the trees are between the road and the walk, they must necessarily lose many roots, if the tree does not have to be removed entirely. Where the grade is raised, the trees are suffocated unless very strenuous measures are taken. In such cases a well of about 8 feet in diameter is sometimes built around a tree, and this kept to furnish air to the roots. It does little good, however, unless there are radiating pipes from the base of this well to carry air out to that part of the root system which needs it most. If it is possible to fill in gradually, the tree will sometimes send its roots up in proportion to the filling in. Many trees will not stand such treatment, however, and it is often better to cut out and replant. Wherever trees have lost part of their root system for any of the above reasons, they should be pruned correspondingly heavily.

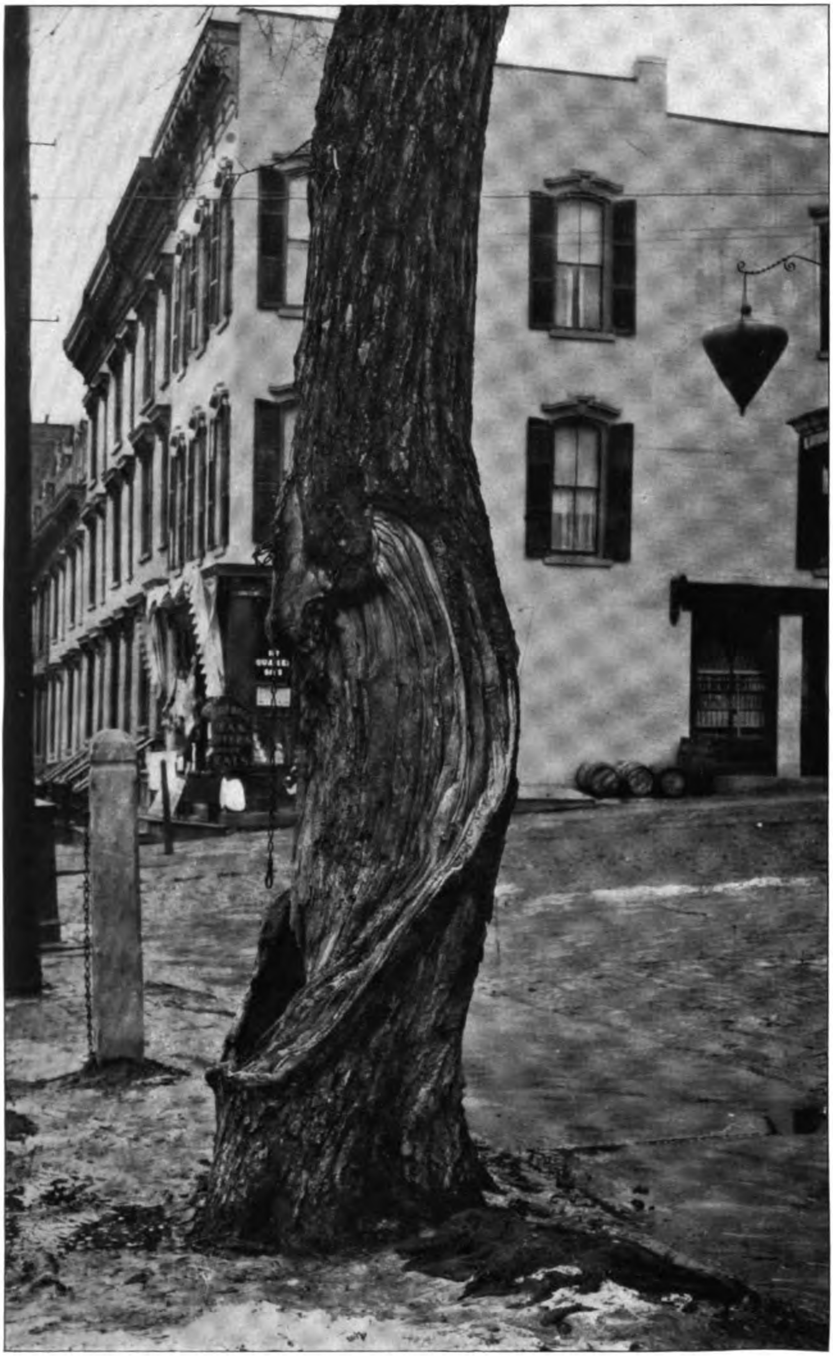
TREE SURGERY.

Tree surgery, commonly known as tree doctoring, has received great stimulus of late. There are many good features to tree surgery, but it has been carried to an extreme by men more or less ignorant of the subject, who prey on wealthy tree owners for the very large prices which they collect for usually very inferior work. One of the most prominent companies in this work has the audacity to charge several dollars a day over and above the wages of the man performing the work, for the idea which it claims to have originated. If one thinks of having some such work done, he should be very careful to employ responsible persons.

The first thing which tree surgery calls for is the correct pruning of a tree.

Pruning.

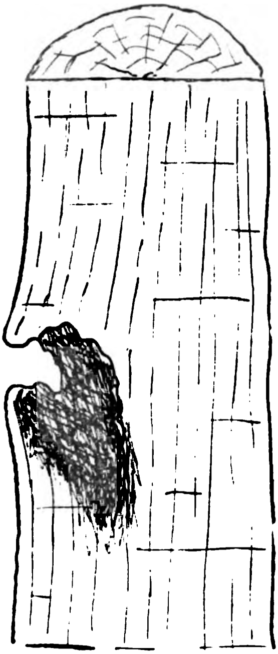
This is an extremely broad subject, which can be little more than touched upon in this work. Scientific pruning has many objects in view, such as the size and form of the tree, the securing of better flowering and pruning conditions, the getting rid of disease, the getting rid of insect or other injuries and the increasing of the vigor of the remaining parts.



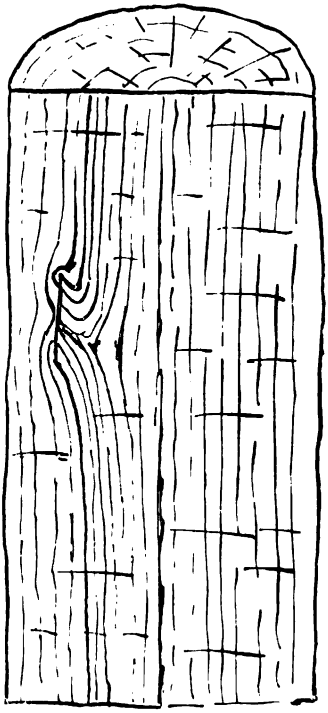
Damage due to Horses

We must consider the species very carefully in all pruning operations, as some trees will stand much more pruning than others. The ability of a species to sprout seems to bear a direct relation to hardiness in pruning.

A tree should be trained from youth in the way it is ultimately intended to be and it should be pruned annually, thus doing away with great loss and energy by cutting off the larger branches after a period of years.



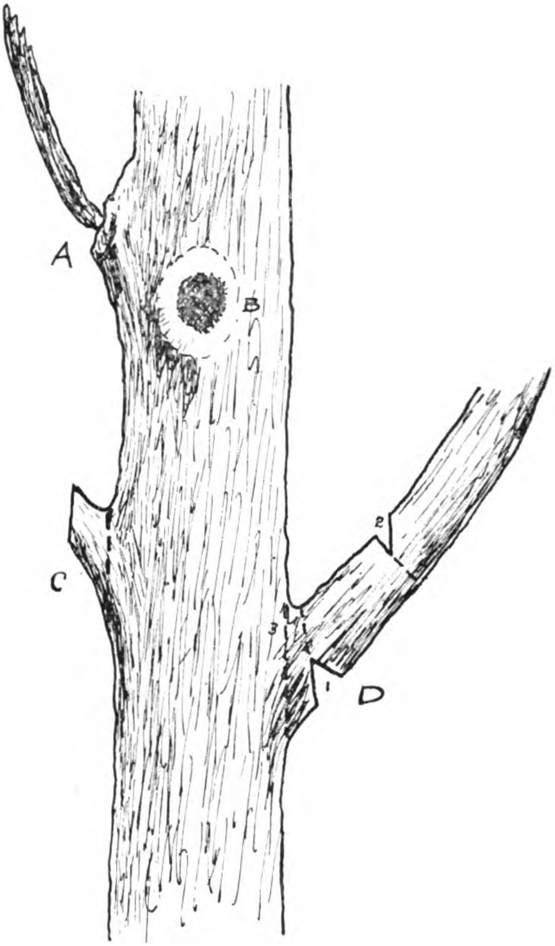
The Result of Improper Pruning.



The Result of Proper Pruning.

As to the time of year when pruning should be done, there is much difference of opinion. The balance seems to be in favor of late autumn and early spring for all species except those which bleed badly, as the maples and birches. These species should be pruned in the winter. If flowers are wanted, pruning must be deferred until after the bloom.

In pruning a tree, the first operation is to get rid of all dead and dying branches. They should be cut off back in the living wood. All branches should be cut so that they do not split the tree. With little branches there will be no trouble, but with larger branches a notch should be made on the under side, close to the tree, first. This should be cut about half way through. The branch can now be cut off at a point 6 or 8 inches beyond this notch, so that when it breaks down, it splits into the first notch.



A Dead stub.
B Wound or limb scar not closing.
C Showing improper pruning. Should have been cut on dotted line.
D Shows cuts necessary to successfully remove large branch. Notch cut at 1 first, notch and saw cut at 2 next, then saw cut at 1, and last saw cut at 3.

If the piece left is not too heavy, it can all be taken off in another cut, which should be parallel to the side of the tree to aid in closing the wound. If the piece is heavy, a second cut is taken into the first notch and then a third cut is made close to the tree.

After the dead branches are cut out, the next consideration is the form. There are so many factors which come into this that it is hard to lay down any rules. It will suffice to say that all irregular and unsightly branches must be trimmed out and after that, the symmetry should be carefully studied. Do not allow the tree to grow one-sided. The desired proportions of the height and width of the crown to the height of the tree should be carefully preserved.

In proper pruning, pruning shears will be used rather than the saw wherever it is possible, and all cuts should be made close to the tree or branch. All wounds should be dressed immediately with a heavy lead paint or tar to keep the spores of fungi from gaining an entrance to the tree at this place. Paint is usually the better in the matter of appearance. A second or third coat should be applied if the first shows any signs of breaking its surface.

Tree Rejuvenation.

The great stronghold of the tree doctors has been through rejuvenating old trees that have become weakened through decay. They do this by cutting out the decayed wood and filling the cavity with cement. This practice has been carried to an extreme. It does little good as a rule to fill the great holes in over-mature trees with cement. It improves the appearance but it is questionable just how many years is added to their lives. The filling of such a cavity corresponds very closely to the filling of a tooth. If any decayed matter is left in the tooth, the whole job counts for nothing. In the case of a tree with a large cavity, it is practically impossible to clean it absolutely of all dead material and the tree is usually so far gone that it cannot be saved anyway.

In the case of small openings it is a different proposition. Here, much good can be done by the complete cleaning out of dead matter. The cavity should then be washed with a fungicide, painted with a heavy paint and filled with cement. If given half a chance, a tree will recover from such a wound very quickly.

Sometimes a large branch is partially torn away from the trunk and it is much desired to save it. This is best done by boring a hole through the limb at right angles to the split, running a bolt through with head and washer on the lower side and fastening by a piece of chain to a similar bolt through main trunk. Do not pass the chain around branches, as this causes a girdling, and either partial or complete death. It would be well to wash a wound so formed with Bordeaux mixture and then cover with a coat of paint.

Many tree doctors claim they have solutions which, if injected into holes in the tree or into the roots, will act as cure-alls for disease, or give stimulated growth. Such claims are false and the man arguing for such should be fought shy of, as he is decidedly a "quack doctor."

TREE COMMISSIONS.

There is no reason why the whole care of city and town trees should not be done through a commission by a city forester. This commission should be outside of politics. It should establish a nursery to grow suitable stock and should do the cutting and planting for the entire town, thus insuring symmetrical and artistic conditions. The fight against disease and insects would be carried on by this commission, and last, but not least, the education of the public in the proper care of street trees. By doing this work from a central commission it would be done properly, at the right time and with vastly less bother and expense.

A commission of this nature is able to spray trees for about twenty-five or thirty cents per tree, where the individual would have to pay one or two dollars or even more. A few cities already employ city foresters to look after these matters. Let your city be the next one.

There is then no reason why a tree should not live forever if planted and maintained under the proper soil conditions, if the roots and trunks are not mutilated and if it is kept free from disease and insects. A careful watching of the tree from youth will therefore add many years to its life and to the pleasure of those who may enjoy it.

LEGISLATION ENACTED BY THE STATE OF NEW YORK IN REGARD TO SHADE TREE PLANTING.

Laws of 1863, Chapter 93.

AN ACT to authorize the making of sidewalks and planting of shade trees along highways of the State other than in cities and incorporated villages.

Section 1. Provides that persons owning property on the highway may make walks and plant trees, such walks with the trees being limited to 6 feet in width from the outward line of highway, provided highway is not over 3 rods wide. One additional foot may be added to the walk for each additional rod to road.

Laws of 1869, Chapter 322.

AN ACT to encourage the planting of shade trees along the sides of public highways.

Section 1. Any inhabitant liable to a highway tax, who shall transplant by the side of a public highway any forest shade tree of suitable size, shall be allowed by the overseer of highways an abatement in his highway tax of $1 for every four trees so set out, but no rows of elms shall be placed nearer than 70 feet, no rows of maples or other forest trees nearer than 50 feet, except locusts, which may be set 30 feet apart, and no allowance, as before mentioned, shall be made unless such trees shall have been set out the year previous to the demand for such abatement tax and are living and well protected from animals at the time of such demand.

§ 2. Any trees transplanted by the side of the public highways, as aforesaid, in the place of trees which have died, shall be allowed for in the same manner and under the same conditions as in the preceding section.

§ 3. No person shall be allowed an abatement of his highway tax as aforesaid more than one-quarter of his annual highway tax and no one shall receive any abatement of tax for trees transplanted previous to the passage of this act.

Laws of 1874, Chapter 570 (amending Laws of 1863).

Section 1. Changed to read that the walk may be 6 feet wide from the outward line of highway to center line of trees, also when the highway is more than 3 rods wide, the central line of trees may be extended into highway from its outward line a distance equal to one-fifth part of the width of highway, provided it shall not exceed the 11 feet from the outward line of highway.

§ 2. Provides penalty for defacement of tree, making it a misdemeanor, punishable by a fine of $50 and imprisonment for thirty days, or both.

Laws of 1875, Chapter 215.

AN ACT to prevent the mutilation of shade or ornamental trees.

Section 1. It shall be unlawful for any persons whatsoever in this State to hitch any horse or other animal to, or leave the same standing near enough to, to injure any fruit or forest tree that has been transplanted or used as a shade or ornamental tree around any schoolhouse, church or public building or along any public highway.

§ 2. Any person or persons guilty of violating the provisions of section 1 of this act shall be liable to prosecution by any person before any justice of the peace in the town where the offense is committed and punishable by a fine not exceeding $100 nor less than $10, besides the costs of the action, and every such penalty, when collected, shall be paid by the justice one-half to the overseers of the poor of the town in which recovery was had and the remainder to complainant, and the same process and means for the collection of the penalties imposed by this act may be issued and had as are now allowed by law for the collection of damages in actions of court, but no provision of this act shall operate to interfere with any ordinance of the incorporated villages and cities of this State intended to secure the protection of shade trees therein.

Laws of 1877, Chapter 451.

AN ACT for the more effectual prevention of wanton and malicious mischief and to prevent the defacement of natural scenery.

Section 1. Provides a maximum fine of $250 and imprisonment for six months, or both, for defacing any ornamental tree, public or private, or natural scenery, or the placing of advertisements thereon.

§ 2. The person liable to conviction is also liable to suit by person injured for an amount equal to five times the damage.

§ 2. Provides that in case the owners of the property so defaced do not bring action within six months after defacement the overseers of the poor may bring such action.

§ 5. Provides that the overseers may obtain judgment for damages to an amount not exceeding $250.

Laws of 1881, Chapter 233.

Section 1. Provides that the commissioner of highways may order property owners to plant trees along highways at their own expense.

§ 2. Provides that such order and map showing location of sidewalks and trees shall be filed in the office of town clerk within ten days of order.

§ 3. Same as section 2, chapter 570, Laws of 1874.

Laws of 1888, Chapter 196.

AN ACT to encourage arboriculture.

Section 1. The Friday following the first of May in each year shall hereafter be known through the State as Arbor Day.

§ 2. Provides for the duties of chief officer of public schools in providing public exercises, " as shall tend to encourage the planting, protection and preservation of trees and shrubs."

§ 3. Provides that the State Superintendent of Schools shall have the power to prescribe in writing a course of instruction which shall be observed by the public schools authorities on Arbor Day.

Laws of 1905, Chapter 502.

AN ACT to amend the Town Law in relation to shade trees and the appointment of a tree warden.

Section 1. Provides that a tree warden must be appointed if petitioned for to the town clerk by twenty-five taxable persons. He shall serve one year and shall receive reasonable compensation. He shall have full control of all public trees and shall prosecute for injury to such trees. He shall have charge of money appropriated for setting out trees. Two hundred dollars may be appropriated for the care and setting out of trees.

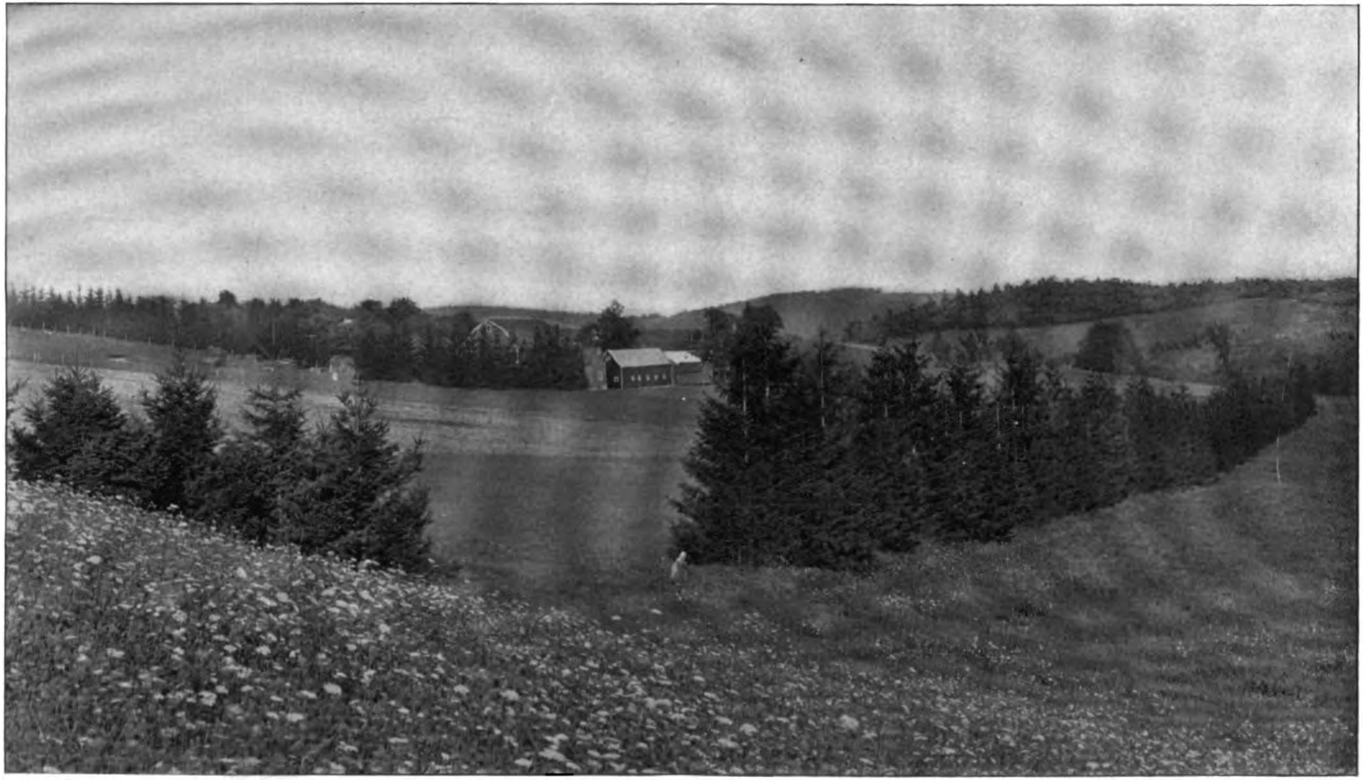
Laws of 1910, Chapter 626.

Enables the city of New Rochelle to raise by taxation $3,000 for the care of city trees.

Laws of 1910, Chapter 397.

Section 280, paragraph 6. The board of public works of villages shall have power to regulate the planting, trimming, rearing and removing of trees in the streets, public parks, etc.

Paragraph 7. Shall have the power to improve and ornament the public parks, etc.



Forestry and the Farm.

Well-located *windbreaks* for the buildings; and *woodlots* on the hilltops, where the soil is poor and cultivation difficult.

Walter Mulford

STATE OF NEW YORK
CONSERVATION COMMISSION

BULLETIN 9

WOODLOT FORESTRY

A MANUAL OF FORESTRY
FOR
USE ON FARMS AND COUNTRY ESTATES

BY
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ACKNOWLEDGMENTS

In order to make this Bulletin as useful and reliable as possible, use has freely been made of every available source of information.

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Readers who may have difficulty in understanding any part of the text, or who may have information which they deem specially valuable — especially in connection with profits, or detailed problems — will confer a favor on the author by writing him. This will be specially useful in revising the text for future editions.

THE AUTHOR.

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WOODLOT FORESTRY

I. GENERAL SURVEY OF WOODLOT CONDITIONS AND FORESTRY

PURPOSE OF THE BULLETIN

The woodlots of the farms and country estates of New York have, for the most part, been treated with *mistreatment!*

Neglect and abuse have been the keynotes by which the owners have been guided in managing this valuable resource. Even the progressive farmers of the State, who pride themselves on crop rotation, intensive methods, alertness and business on the rest of their farm, are following the old careless, if not ruinous, methods in their woodlots.

To point out the importance and value of the woodlots to the State and the individual owners; to stimulate the owners to the practice of forestry in their woodlots, securing for themselves and to the State the many benefits and great profits which well-managed woodlands yield; and to point out clearly and simply the principles and methods of correct forest practice — these are the aims of this bulletin.

IMPORTANCE OF WOODLOTS

A Great Source of State Wealth. The woodlots of the State represent, in the aggregate, an enormous source of natural wealth. Statistics show that, of the 30,498,560 acres net land area in this State:

22,030,367 acres are in farms (including woodlots).
900,000 acres (approximately) in roads and cities.
7,568,193 acres in forest regions.*

30,498,560 acres.

Of the farm area, we find:

14,844,039 acres (67.4%) improved land.
2,750,183 acres (12.5%) unimproved land.
4,436,145 acres (20.1%) woodlots.

22,030,367 acres (100%) farms.

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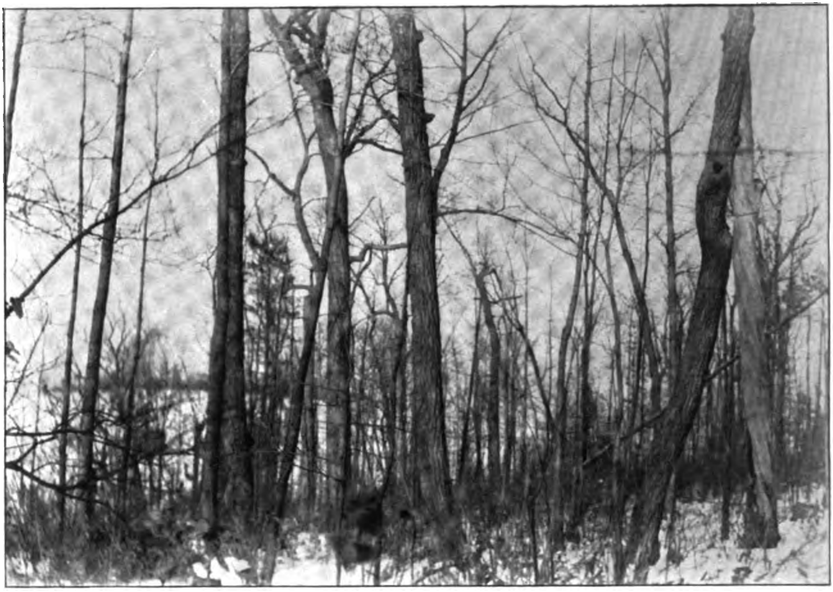
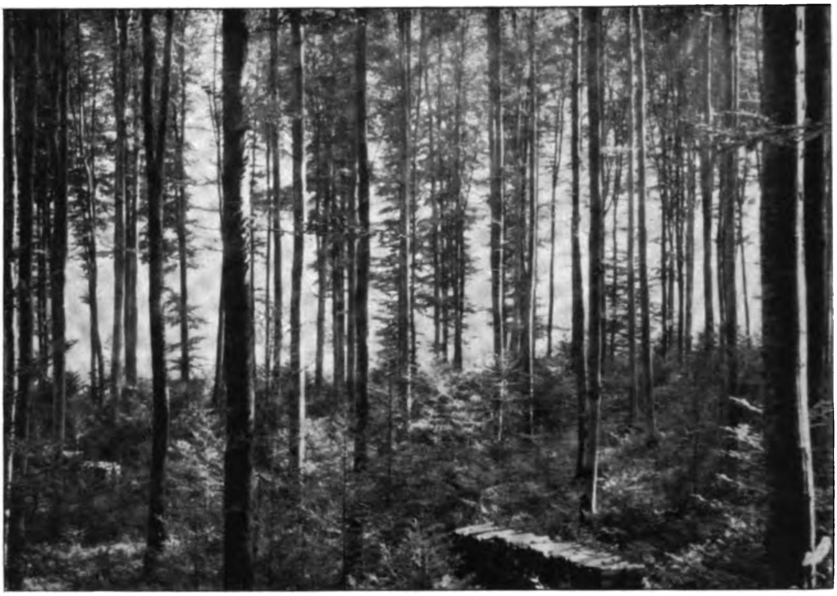
* By "forest regions" is meant extensive bodies of land (at least 100 square miles), where there is less than one-half the surface cleared. There are eight such regions in the State.



Typical New York State Woodlot.

Result of successive cullings of the best remaining trees at each cutting; and general neglect. Old trees of inferior grades; and no valuable young growth coming in.



The Woodlot As It Should Be.

Ground fully occupied by thrifty, valuable trees. Cuttings made to improve the remaining stand, and to secure a new stand of the best kinds. Young growth already started.

This gives a total area of woodland of 12,000,000 acres in the State, or about 37 per cent. of the whole land area. Including the waste lands in farms, which are best suited to forests, about 40 per cent. of the whole State is best adapted to timber growth.

On the 22,000,000 acres in their farms, we find the farmers allowing practically one-third of their land to go without improvement — 4,436,000 acres, as woodland, abused and neglected; and 2,750,000 acres as neglected bare land. It is probably very safe to say that at least 814,000 acres of the unimproved farm land is best suited to forest growth, thus giving a total of *5,250,000 acres, or 23.9 per cent.* of the farm area in this State, best adapted to forest growth.

In addition to this, in the forest regions of this State, a fair estimate of the land owned by farmers, or held in smaller estates, best adapted to forest growth, would be 2,250,000 acres.

Thus, we find *7,500,000* acres best suited to forest growth, in comparatively small holdings, on which all necessary work can be done by the permanent labor force at times when it cannot be otherwise profitably employed.

Conditions thus are ideal for intensive management of this great forest area.

At present, it represents one of the least intelligently used assets of the State. Under intelligent and intensive management, the owners should earn from these 7,500,000 acres, a *net profit* of *at least* $15,000,000 per year, and produce for the industries of the State, 3,750,000,000 (3¾ billion) board feet of lumber each year.

To the Individual Owner. VALUE. To the owner, the value of this woodland is made up of many factors.

(1.) *In products derived.* The most common products are lumber, poles, ties, fence posts and firewood. Besides these, many special uses may be had in different localities, such as pulpwood, implement wood, etc. There are also many special products which may be developed — thus, gathering seed of desirable species often will yield a good profit. The value of these products is sufficient, under good management and under average farm conditions, to provide a fair net return from the lands, and make the woodlot areas pay their fair share in the farm profits.

(2.) *As a profitable use for labor and teams during the winter months.* Unquestionably one of the biggest problems on the farms today is to secure and keep good help. This can generally only be done where year-round work is given; and the woodlot offers one of the most satisfactory solutions of the problems.

The Woods A Winter Crop.
Profitable use for labor and teams during the winter months.

(3.) *As a windbreak.* A belt of woods has proved of great value in protection against the direct mechanical effect of winds (blowing down of crops, especially fruit; shifting sands); against drying of soil; to a lesser extent in securing an even distribution of protective snow cover, and shelter after the snow has melted, for winter crops; and in very greatly increased comfort to people and stock. This spells increased profits in better and larger crops; and last, but not least, in greater comfort in the home.

(4.) *As one in a diversity of crops.* It is a well-established principle now in successful farming, not to have "all the eggs in one basket." The wood crop is one which always has a market at a fair price; and with the price of the product constantly advancing. It can truly be called a winter crop, as the cultivation (improvement cuttings, planting, etc.) can be done at times not required by any other crop.

(5.) *As a reserve fund, and insurance against calamities or unusual economic conditions.* In this connection, the woodlot may be compared to a high class bond investment, and is better than such investment. Good sized thrifty material of desirable species is always marketable at a fair price, earning a fair rate (4 per cent. or more) of compound interest all the time by its growth in volume; in addition, it is growing in value, both through increasing prices of wood products, and because material from larger trees is more valuable than that from smaller trees. After some calamity, such as barns burning, or crop failure, it can then be utilized when most needed; or, for example, during a coal strike, when other sources of fuel cannot be had, except at exorbitant prices and with great inconvenience.

WASTE LAND ON THE FARM.

(6.) *Utilization of otherwise non-productive areas.* Nearly every farm has some land which cannot be profitably used for farming crops. This may be stony, rocky land, wet land which cannot be drained, pure sands, steep slopes, especially if subject to excessive erosion (washing away), etc. Frequently, because of irregularities in boundary lines, a considerable amount of land cannot be used without undue expense in extra fencing, etc. Again, many times, because of labor conditions, a piece of land which might otherwise be used for pasture or crops, is not needed, and could profitably be used for tree growth.

(7) *The aesthetic value* is a factor which cannot be accurately measured in its value to a place. Certainly it is considerable. For example, on a country place the difference between attractive woods and scrubby worthless brush or waste places would be enough to make a great difference in the value attached to the whole place; and for purposes of sale, an attractive place could be disposed of very much more easily than an unattractive one. In fact, an attractive grove of trees might often be the determining factor in a sale.

Or, if one goes to buy a farm and sees a piece of poor brush land or waste land his estimate of the value of the whole place is much lowered; if that same piece is covered with a well-set thrifty grove, even if young, his estimate of the value is raised.

(8.) *Protection to water supply.* Around springs a piece of woods is one of the best means of providing against their drying up. In country places where a large and abundant supply of pure water is desired, the maintenance of woodland around the source of supply is a very valuable means of conserving it.

As a special problem, the value of woods on village, town and city watersheds is especially great. In such cases a considerable area of land must generally be held anyway to protect the purity of the water supply. This purpose can best be advanced by the maintenance of a good forest cover on the land, which will also prevent the silting up of the reservoirs, and irregularities in supply; at the same time yielding a profit from the use of the land.

There are still other uses which are hard to classify. Thus, it is well known that in keeping insect attacks on valuable farm crops under control, insectiverous birds, etc., are of great value. These always are able to thrive better when woodlots are at hand, in which to nest and seek shelter.

Costs and Profits. Thus, in casting up accounts of the woodlot, it is seen that many factors, other than mere cash profits from the products derived, must be considered. At the same time, it is well to know just what financial return can be expected.

Unfortunately on this point there is lack of accurate data for the whole State. The following examples will illustrate the possibilities:

(1.) In Western New York, a woodlot was heavily culled of most of its merchantable material in the past two years. There was left, however, about 202 valuable trees per acre on this portion, betsides 146 trees which would best be removed to improve the stand. Most of the valuable species were hickory, white oak, red oak and white pine. At the rate of growth, as determined by measurements, and at average present market prices, in twenty years from now there would be value produced sufficient to earn the equivalent of a net annual income of $3.27 per acre at 5 per cent. compound interest; figured for forty years ahead, the net return would be $3.31 per acre per year, because of the more valuable material produced from larger trees.

This is disregarding the fact that at the end of these periods, timber prices are sure to be much higher than now, and also the fact that this stand is not fully stocked with valuable species.

An interesting and typical condition also presented here, in the possibilities of improvement of the stand, is that if the owner were to cut the 146 trees whch ought to be removed, together with some good material on the ground, he would secure about 3½ cords of wood, worth much more than the cost of planting a sufficient number of desirable trees, so as to secure a *full* stand of valuable species, and thus greatly increase the net profit per acre.

(2.) In Southern New York, a thirty-five acre lot of mixed hardwoods was cut and the net proceeds from the timber sales amounted to $4,939. Men who knew the history of this woodlot asserted that 75 per cent. of the wood had grown in the past twenty-two years. That is, the lot was cut over twenty-two years ago, and the greater part removed. According to these estimates, $3,704 worth of timber grew on the thirty-five acres in twenty-two years. This is $106 per acre, or $4.82 per acre per year. This land would not sell for as much as $15 per acre. It received no care. If the diseased trees and weed trees had been cut and the woodlot looked after as a farm crop, the income would have been much greater.

These examples are based on lumber sold under present market prices of stumpage or round logs. To the farm and country estate, the chief value of the woodlot is to supply lumber, posts and fuel, at least in times of emergency. The purchase price of these materials is generally very much greater than is received for material sold; and used as a source of home supply, the woodlot would yield much greater financial profit than indicated above.

Again, it is worth while remembering that the direct value of products derived is but one of many benefits derived from the woodlot; and it is especially urged, in view of the common misconception of the subject, that the income from better management is *not* something which will be enjoyed only by our great grandchildren, who, as one wag said, "Never did anything for us;" but is constant, with financial returns camparable at least to those from a high-class bond investment.

WHAT FORESTRY IS

The objects of forest management are to secure the greatest return, in the least time, of the best trees, at the least expense, in such a way as to improve the land and forest conditions, and fully to satisfy all the interests of the owner. Forestry tells how to accomplish these objects.

WOODLOT HISTORY

How Present Conditions Developed. In the development of the woodlot, we must turn back and consider the conditions under which they developed. When the first settlers came here, they found an almost unbroken wilderness. The forest had to be destroyed to clear land for agriculture. It had no value — in fact, it was considered an impediment. With that attitude, there was no effort made either to protect the forest from fire or other damage. Similarly, in the use of wood — at first only the very best trees of the best species would be taken for any purpose. With the gradual culling of the woods, we have to-day woodlots consisting mostly of culls or inferior stock. Most of the hardwoods are either the third or fourth set of sprouts from the same stump, and thus of very low vitality, or are seedlings of poorer species; the evergreens are, of course, of seedling stock, but the proportion of these is very much lowered, and these generally also are of weakened vitality. In addition, practically all the woodlots are damaged by fire, grazing, poor conditions for growth, often by insects or disease, so that to-day practically no woodlot is as thrifty as it should be. When the good farm land was cleared, then the poorer lands were attacked, and this continued, until to-day we find thousands of acres (probably 800,000) which, being best adapted to forest growth, should never have been cleared.

On the other hand, wet lands, a little difficult to handle because in need of draining, were mostly left uncleared, and frequently we find the best land on the farms under woods. Nor was any notice taken of the value of woods for windbreaks, etc.

So there is no fixed relation between the actual location of the woodlot and the location which would give the fullest possible benefits of an equal area of woodlot on the farm.

Now, all these conditions have changed. It is certain that intelligent and careful management of land, best adapted for the woodlot, will prove a profitable investment. This investment will generally consist of time and labor, which otherwise would be less profitably employed or else would lie idle (winter work); and in the foregoing of certain present cash returns when trees, which might be sold, are left to grow; and to a limited extent, in actual outlay of money, for trees to plant, in marking trees for cutting, or in other extra work in woodlot improvement.

A PROGRAM OF MANAGEMENT

What Is Practical in Forestry for the Ordinary Farm or Estate? What is practical in any given case must, of course, depend on the specific conditions involved. In general, the application of management will be in about this order:

(1.) **Protection,** principally against fire, often against grazing; and to a lessor extent, against diseases and insect attacks. Protection is closely connected with

(2.) **Damage cuttings** of waste material on the ground, dead or dying trees, etc., which make the worst fire traps, and breeding places for diseases. This, in nearly every case, can be done at a profit, as the material yielded will pay for the labor.

(3.) **Avoiding Waste.** In this connection may be mentioned the use of better and more careful methods in the woods:— cutting low stumps; working up all material in tops and limbs; working everything into its most profitable form; taking care not to injure remaining trees when cutting or hauling in the woods, etc. All this is closely connected with

(4.) **Cuttings made of standing timber, in such a way as to improve conditions.** While discussed more in detail under the subject of management, these are broadly divided into (1) improvement cuttings, in which the principal aim is the removal of those trees which should be cut for the benefit of the remaining stand; and (2) reproduction cuttings, in which the main idea is to secure a new crop from seed of the most desirable species.

(5.) **Planting or sowing** either on the open waste places; or in existing woodlots, where these are too open, or where they contain too great a proportion of inferior species; or for windbreak or aesthetic effects, etc. Planting is very closely related to the relocation or change in area of the woodlot, where necessary to secure the best results from a given area of woodlot — that is, where the sum total of all the factors of value, as enumerated previously, is the greatest.

(6.) **A plan of regulating the cut.** Such plan may be to secure a certain amount of material of given quality and size every year, or at regular periods. A plan for an equal annual cut is rarely practicable in ordinary woodlots, as now found, because the area under management is too small and its condition too poor. However, it is practicable to aim for an annual cut not to exceed the annual growth; or for a cut less than the annual growth, accumulating a reserve fund for larger timbers to be cut at more or less definite intervals. Where possible, this involves a definite system of forest management.

II. PRINCIPLES OF FOREST GROWTH

Conditions Governing Growth of Trees and Forest Stands

FACTORS OF GROWTH

All tree growth, like other vegetation is governed by the environment in which found. This is true of individual trees, of species, and of types or communities. To be successful in forest management, the practice must conform to the conditions and full advantage must be taken of the factors of growth which control in any given situation.

These factors fall into two great groups, not however, clearly defined. These may be termed the " Natural " factors, including only the broad features closely related to climate, etc., over which man has but little control; and the " Subsequent " factors, brought about mainly by man himself, or through changes which he has wrought.

Briefly, the great natural factors of growth are: Moisture, heat, light, soil, slope, aspect and wind.

Moisture. This is a most important factor in tree growth. Without moisture trees cannot grow. But different trees differ widely in their demands for moisture, and only those trees adapted to the moisture conditions should be used in a given situation. For instance, the red pine can grow on very dry sites, while the black ash must have moist ones.

However, it is the minimum amount of moisture which any tree must have that is most important. Up to a rather high per cent. of moisture, such as in permanently soggy ground or in swamps, almost any tree can do better, the greater the amount of moisture it has.

Therefore, in forest management, it is important not only to use species adapted to the general moisture condition, but to use such practices as will conserve and improve the moisture factor.

As a general proposition, the woods and waste lands of the farms are either the driest or the wettest ones.

On the dry situations, the best practice requires the keeping of a good forest cover, sufficiently dense to prevent drying out of the soil by sun and wind.

On the very wet situations, frequently much can be done to improve moisture conditions by a small amount of ditching. Often, land which is called too wet and cold and now left to grow to worthless scrub, with proper drainage can be turned into the most fertile part of the farm. Again, there are opportunities on such land for special crops, such as basket willow. If left in ordinary woodland much can be done by laying special emphasis on selection of species best adapted to the particular site, perhaps supplemented by some simple ditching.

As to moisture requirements, the following table shows roughly the relative characteristics of some of our most important trees:

TABLE I.

RESISTANCE TO DROUGHT

<table>
<tr><th colspan="2">Low</th><th colspan="2">Medium</th><th colspan="2">High</th><th colspan="2">Very high</th></tr>
<tr><td colspan="2">Beech
Birch
Maple
Tulip</td><td colspan="2">Chestnut
Elm
Oak, White
Walnut</td><td colspan="2">Aspen
Oak, Chestnut
Locust</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="2">Ash
Basswood</td><td colspan="2">Hickory
Oak, Red
Popple</td><td colspan="3"></td></tr>
<tr><td colspan="2">Balsam
Cedar, White
Spruce
Tamarack</td><td></td><td colspan="2">Pine, Red
Pine, Pitch</td><td></td><td colspan="2">Pine, Jack</td></tr>
<tr><td></td><td colspan="2">Hemlock</td><td></td><td colspan="2">Cedar, Red</td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2">Pine, White</td><td colspan="4"></td></tr>
</table>

REQUIREMENTS OF TREES WITH REGARD TO AMOUNTS OF SOIL MOISTURE.

High	Moderate	Low	Indifferent as to amount of moisture
Balsam Cedar, white Tamarack	Pine, white Spruce	Pine, Jack Pine, Pitch Pine, Red Pine, Scotch	Hemlock Cedar, Red
Ash, black Elm	Ash, white Basswood Maple Tulip		
	Beech Birch Cherry Chestnut		
		Hickory	
Oak, Pin Oak, Swamp white	Oak, red Oak, white Popple Walnut	Oak, Chestnut Locust Oak, Black	

Heat. This is one of the chief factors in the distribution of trees. Thus, the forests of Northern New York are of different species and types from those of Southern New York. It is necessary to know the requirements of trees with respect to heat in order to determine whether they can be used or not. It is especially important to know the susceptibility of any given species to late and early frosts. Thus, the catalpa, widely heralded as a most valuable tree, is not adaptable over most of New York, being too frost-sensitive. Again, certain species, although they will be able to live under the lower temperatures and shorter seasons of Northern New York, or in the mountains, grow so slowly as to be undesirable, while in warmer districts their growth is rapid enough to make them valuable.

Beyond this choice of suitable species, we have little control over the factor of heat. The indirect effect of heat, such as the drying out of the soil, can be obviated, but this really is directly an effect of moisture conditions.

Minor influences of heat, such as sensitiveness to frost-cracks, can to a certain extent be controlled by regulating the density of the stand, etc.; in forest practice, trees which are especially susceptible to such injury should not be unduly exposed but maintained in more closed groups.

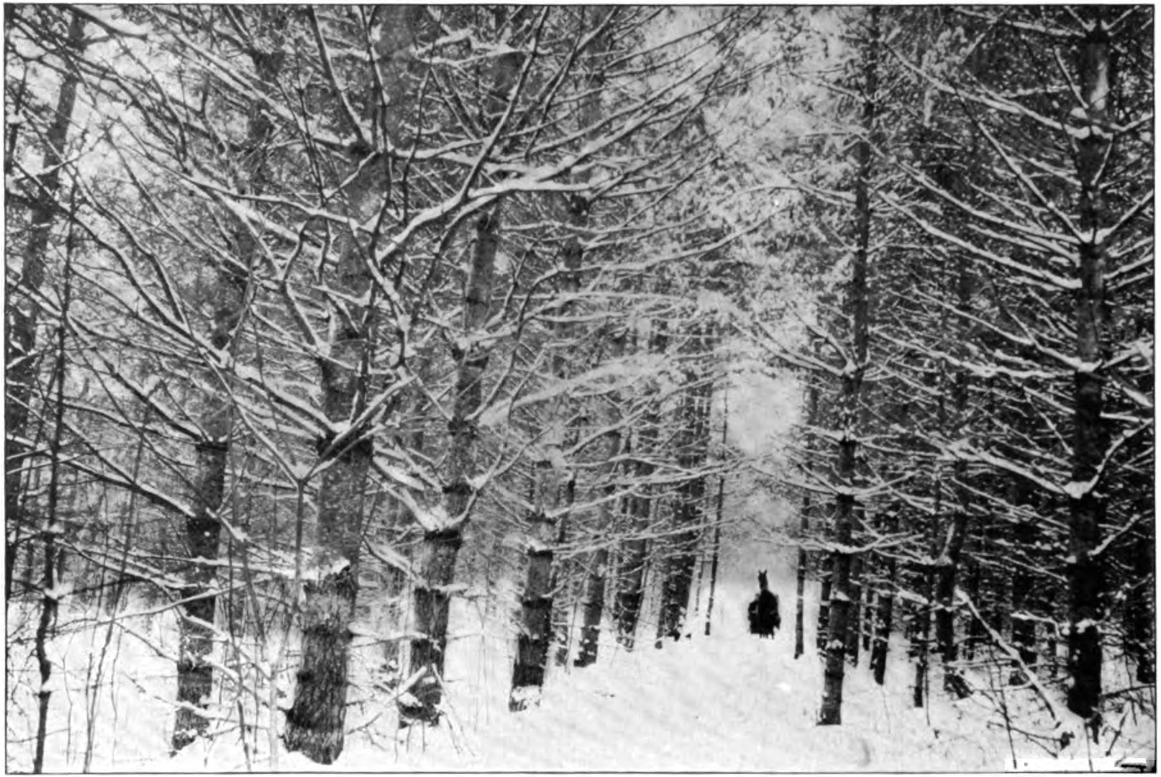
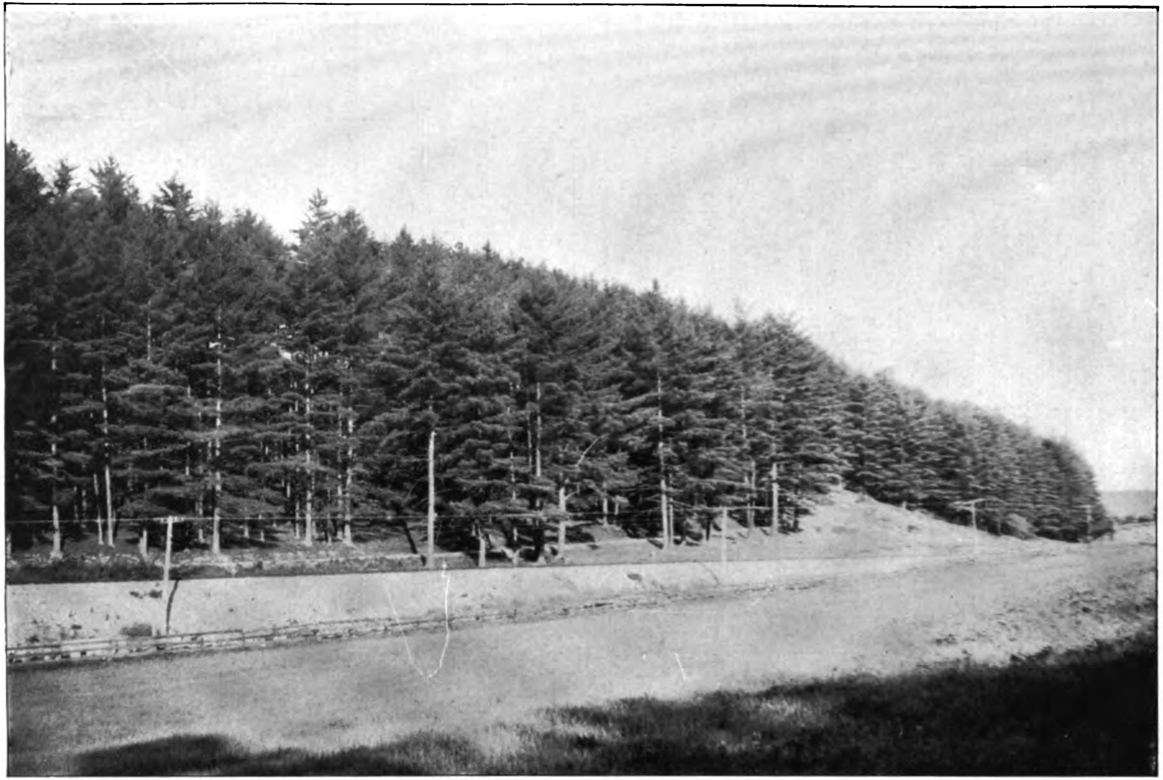


Photo A. Knechtel

Second Growth of White Pine Grown From Wind-Sown Seed. Trees Are Too Far Apart to Shed Their Lower Branches Naturally.



White Pine Grove — Saranac Lake Village. Long Clean Trunks Due to Density of Stand.

Light. Light also is one of the major factors of growth. From a forestry standpoint, it is, with moisture, the most important, because these two are the ones most susceptible to control by forestry methods, and show the greatest difference in returns following proper methods in contrast to improper methods.

Light is absolutely essential to tree growth, as it is this that causes the inorganic plant foods taken from the soil and air to be assimilated by the leaves into higher forms, available for tree growth. Thus, one of the most noticeable facts in growth is the relation of any tree to the condition of light in which it can, and does grow.

Thus, a tree in the open may have its branches low and spreading; while the same species, grown in a dense forest, will have a long, straight clean trunk, with living branches only on the upper portions. This is true, because in the open, the total necessary leaf surface can be most easily obtained by spreading the branches laterally, while in the forest it becomes necessary to keep the crown well up with the rest, in order to get light for the leaves. At the same time, the lower branches, deprived of light, die and eventually fall off, leaving the clean trunk of a forest tree.

In relation to the development and position of the crown (head)* of a tree with respect to the stand in which it is found, a tree is divided into one of four classes:

(1.) Dominant, with full crown and sufficient growing room to the sides, as well as free light from above. When spreading, and shading much more land than it should, the tree is termed a " wolf tree ".

(2.) Co-dominant: Trees just a little below the dominant trees in height, with free light from above but crowded from the sides; not entirely free, nor with full crowns.

(3.) Intermediate: Healthy trees, but far enough below the normal so as to be shaded from above as well as on the sides. Such trees are still thrifty, and usually capable of making full growth if given enough light.

(4.) Suppressed: Those so far behind and completely shaded that the crown development is not much more than enough to keep the tree alive. Such trees may, or may not, recover full vigor if given enough light, depending mostly on the species and the degree of suppression. As a rule, even if recovery is possible, it will be years before full vigor is regained.

A fifth class, of " dead " trees, is sometimes included.

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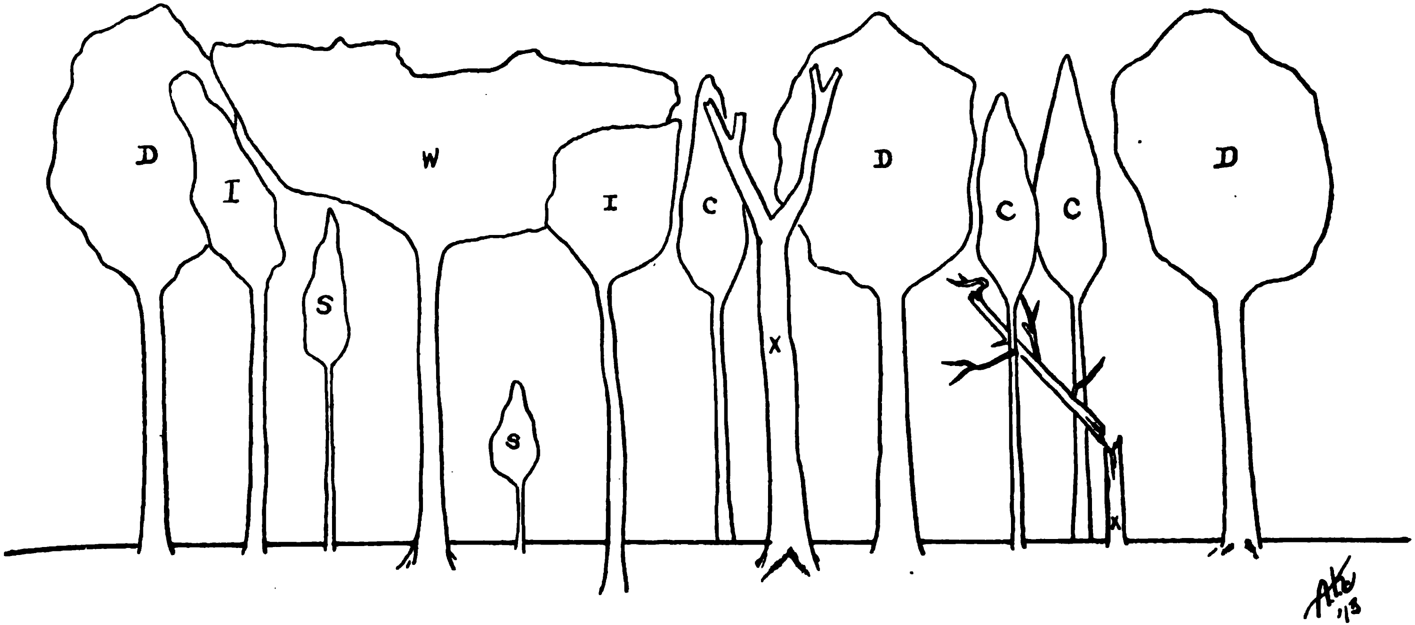
* By crown, or head, is meant that part of the tree from the lowest large living limb to the top.



W — Wolf Trees.
D — Dominant Trees.
C — Codominant Trees.

I — Intermediate Trees.
S — Suppressed Trees.
X — Dead Trees.

Again, different kinds of trees differ very much in their demands for light. Spruce can stand a very large amount of shading, and does not do well in the open; while the Scotch pine demands a great amount of light, and can stand very little, if any, shading. Trees which can stand a considerable amount of shade are called tolerant, those that demand much light and cannot endure shade are called intolerant.

Also, individual trees differ at different periods of their life with regard to their light relations. Most trees can stand at least a moderate degree of shade at the start, and generally demand an increasing amount of light as they grow older.

The demand for light also varies with the situation and district in which the tree is growing.

It is thus important to know the light requirements, not only of the different species, but also at different periods in the life of these species.

Proper forestry methods aim, as far as practicable, to assure enough light to the best individuals of the best species, so as to allow them to make their best growth, and at the same to maintain the stand dense enough to produce good, tall, clean trunks.

There is also an intimate relationship between light and maintenance of the quality of soil, and such features as the seed-bearing qualities of the tree.

The following list gives the varying degrees of tolerance shown by our commoner forest species:

SHOWING TOLERANCE OF SHADE BY DIFFERENT TREES

Very tolerant	Tolerant	Intermediate	Intolerant	Very intolerant
	Basswood Beech Elm Maples	Ash Birch, yellow Butternut Chestnut	Birch, white Cherry Hickories Oaks Tulip Walnut	Popple Locust
Balsam Cedar, white Hemlock	Spruce	Pine, white	Cedar, red Pine, red Pine, Jack Pine, pitch Pine, Scotch	Tamarack

Soil. As with all other plant growth, the kind of soil affects very largely the kind of tree growth found on it, and the quality of that growth. Thus, the red pine can grow on the poorest of sands, while the basswood must have a rich soil.

Any tree will do better on a good soil than on a poor one. But we must not use a tree which requires a good soil on soil of inferior quality.

Just as in farming, good methods maintain and improve the qualities of a soil, while poor methods — the ordinary kind — impoverish the soil, so it is with forestry. The leaves and other decaying vegetable matter add very much to the richness of the soil, forming a good humus and leaf mold. But if exposed to too much light and heat, this humus does not form from the leaves and their nourishment is wasted. So one of the guides to proper forest practice is to maintain such a cover as will improve the soil conditions. This is generally accomplished by maintaining, as nearly as possible, a complete shade for the ground.

At times when reproduction by seed from standing trees is desired, however, sufficient light must be given to do away with the litter, and thus provide better seed-bed conditions.

Requirements of Trees With Regard to Soil

Fertile (rich, deep and preferably well-drained)	Moderate (loams, well-drained, of at least 6 in. depth)	Poor (thin stony ridge)	Poor (sterile sand and gravels)	Swamp
Hemlock Spruce	Pine, white	Cedar, red	Pine, Jack Pine, pitch Pine, red Pine, Scotch	Balsam Cedar (white) Tamarack
Ash Basswood Butternut Cherry Elm Maple Birch, yellow Oak, pin Oak, white Tulip Walnut	Beech Chestnut Birch, white Oak, red Locust	Hickory, pignut Oak, chestnut Oak, black	Popples	

The species itself has much to do with the rate of growth. Certain species, as hemlock, or native red spruce, are naturally very slow growers, while others, as Carolina poplar, are naturally very rapid growers. Of course, all species will grow better on good soils than on poor ones; and under proper forestry methods will grow much better than under poor methods. At the same time, it is important, other things being equal, to favor the most rapid growing species. Thus, generally, red oak should be favored over white oak, as it grows so much faster; while the native spruce and hemlock grow so slowly that it is not best to favor them in the ordinary woodlot.

Knowledge of the rate of growth is especially valuable in choosing trees for planting, as naturally slow growers would not produce enough to pay interest on the money invested.

Characteristics of Trees With Regard to Rate of Growth

Very rapid	Rapid	Moderate	Slow	Very slow
	Pine, white	Pine, red Pine, Scotch Spruce, Norway	Balsam Cedar, white Pine, Jack Pine, pitch Spruce, red	Cedar, red Hemlock
Locust Popple	Basswood Chestnut Tulip	Ash Butternut Cherry Elm Oak, red Walnut	Beech Birch, yellow Hickory Maple Oak, pin Oak, white	Oak, chestnut Oak, black

Other Factors. While moisture, heat, light, and soil comprise the four great elements affecting growth, and the character of the species itself is very important, even in the same district, these factors are subject to many variations.

Slope. The steepness of the slope is an important factor, greatly modifying the factors of light and moisture.

Aspect. The aspect (the direction in which the slope faces, as east or west) is important, in modifying especially the factors of heat and moisture, and to a certain extent, of light. Thus, a south slope, which becomes heated sooner in the spring, is very much more apt to have growth start earlier, and this growth is more likely to be "nipped" by a late frost, which is general over the whole district, than would be the case on a north slope. A south slope dries out more than a north one. And as between south and north slopes, so between west and east ones; and on a ridge running northwest to southeast, for instance, the northeast slopes might have very different conditions of growth than the southwest ones.

Wind. Wind is another factor, acting to a small degree in modifying the forms of trees, but much more important from its modification of the factor of moisture, and still more so in its mechanical effects, in blowing down trees.

In modifying the form of trees, this is apparent mostly on exposed mountain peaks, along the shore, etc., where a dwarfed, bushy form is developed, best to resist the winds.

To prevent drying out of soils, a dense border at the edge of the woods should be maintained.

Should the border of the woods be open, it will be best to plant several rows of such trees as Norway spruce to act as a windbreak.

The mechanical effect of wind — that is the blowing over of trees in the forest — is its most important one. The resistance of different species, as well as of individuals grown under different conditions, is a consideration of importance in management.

Species must be so selected and managed that the danger of windfall is reduced to a minimum. Thus, a species like the spruce with its shallow root system, must be grown in closer stands, and in more protected places than the deep-rooted Scotch pine. Especially in cuttings in dense stands, where resistance to wind was provided by the whole woods, trees must not be left to stand too openly, as the danger from being blown over by wind is too great. This applies especially to shallow-rooted species like spruce. With them different forest practice must be adopted than that used with windfirm species.

DAMAGE TO THE FORESTS. So far we have discussed mainly the natural factors of growth. But much more important, generally, in their damaging effects, are the factors produced by man himself or by conditions which he causes. To a certain extent, of course, these damaging agents are entirely "natural" in their work, and not the result of man's work.

Fire. Most important is fire. Almost all of our woods have been seriously affected by fire.

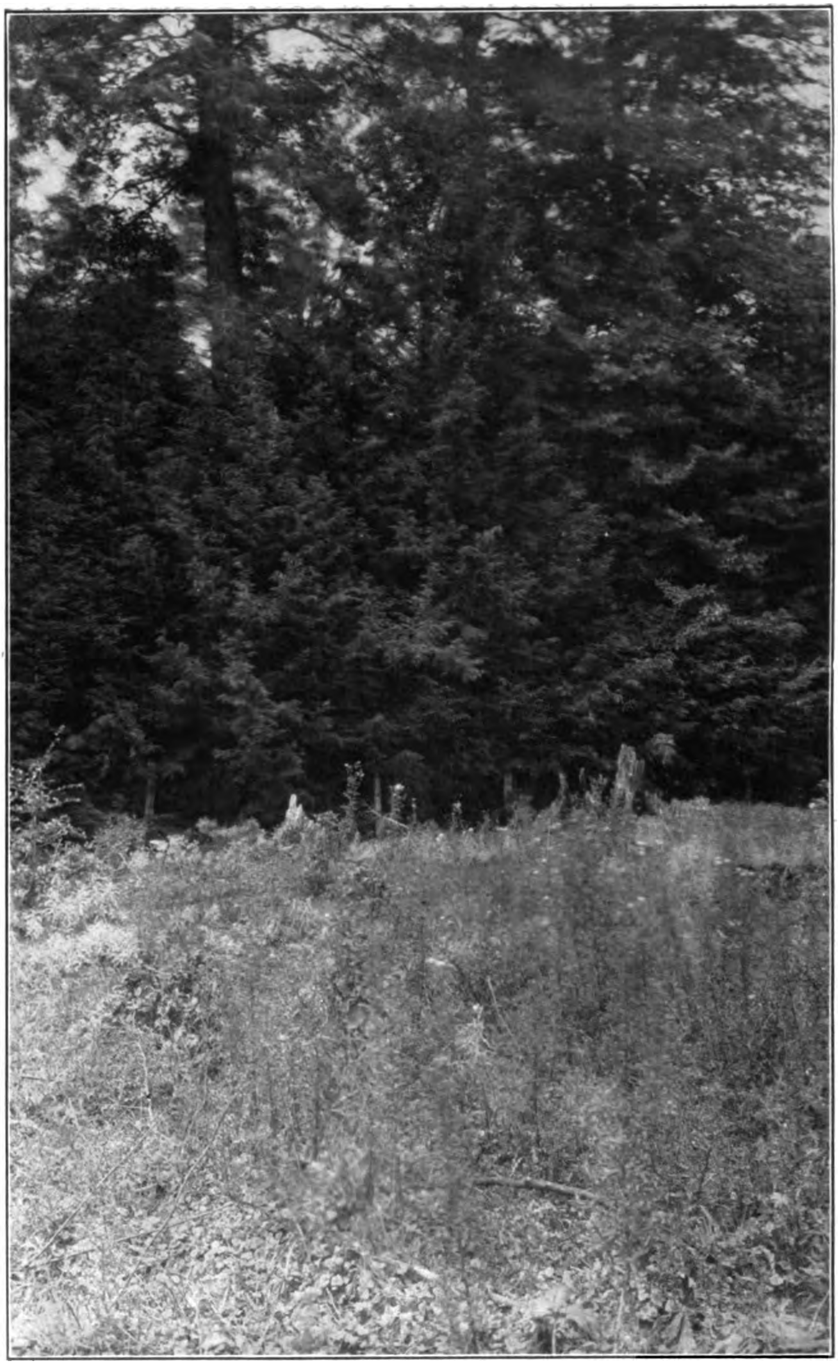


Photo by J. W. Stephen

A Dense Border Around the Farm Woodlot Which Prevents the Wind From Blowing Away the Litter and Insures Favorable Forest Conditions.

The effects of fire are many, and often but little understood or noticed. Thus, the ordinary, light ground fire, which is not thought of as doing damage, burns up the leaf-litter and vegetable mold, which is so valuable in soil fertility. From this alone, the loss is enough to warrant great care in excluding fire. Then, if there is any seedling reproduction on the ground, this is generally killed off, so that desirable new stock cannot get established.

EFFECTS OF LIGHT GROUND FIRE.

If the fire is a bit more severe, enough injury is done to the standing trees to check growth, or at least weaken the vitality of the trees. Generally a wound is produced through which disease or insects can enter and thus kill or seriously affect the tree. Frequently the young saplings and small poles are killed outright, and thus only mature trees past their prime are left standing. These are generally injured so that their value is greatly decreased.

Last comes the fire severe enough to wipe out all the stand.

It is in one of four ways that fires do most of their damage in woodlot:

(1.) By burning up the litter and plant food, making the soil poorer.

(2.) By checking growth, and reducing vitality.

(3.) By injuring tree, so that either loss in quality of wood is effected; or wounds produced through which rot or insects can enter the tree.

(4.) By destroying new young growth, and generally of the best kinds. Thus, all evergreens seedlings may be wiped out, while the hardwoods, through their ability to produce sprouts, may survive; and the poorer species, as birch, increase at the expense of the better.

The principal causes of fire are railroads, brush burning, and carelessness. The question of protection from fire is discussed under Management. In general, however, different species differ considerably in their ability to withstand fire, and allowance for this should be made in the selection of species.

Grazing. In woodlots it is the common practice to turn cattle or hogs into the woodlot to pasture. It is generally believed that this does no harm to the woodlot.

As a matter of fact, only in fairly mature woods does grazing do no damage; and in itself, the fact that there is any pasture there means that the woods are not in as good shape as they should be. If the woods were as dense as the best conditions demand, there would not be enough light on the ground to support a growth of grass, and the amount of pasture would not be sufficient to turn the cattle into the woods. Besides this, cattle browse off young trees and trample down others, and hogs root up many trees, while sheep are especially destructive to very young growth.

Only in special cases should the woods be pastured, such as turning in hogs to root up the ground just before the seed falls in a good seed year, thus making the seed bed conditions better.

As a general thing, a piece of land should be used *exclusively* either for woods or for pasture. Well managed for either use, the return will probably be greater than the combined use for both woods and pasture.

Insects and Diseases. Each year the damage by forest insects and tree diseases is becoming a more serious problem. Especially does the damage from these sources increase with trees weakened by fires, or grazing, or other causes, or in old over-mature trees.

Insects are divided into three classes as to mode of attack, namely, chewing, sucking and boring. From the forest standpoint for practical purposes, the two classes of borers and leaf feeders (chewing) are the most important.

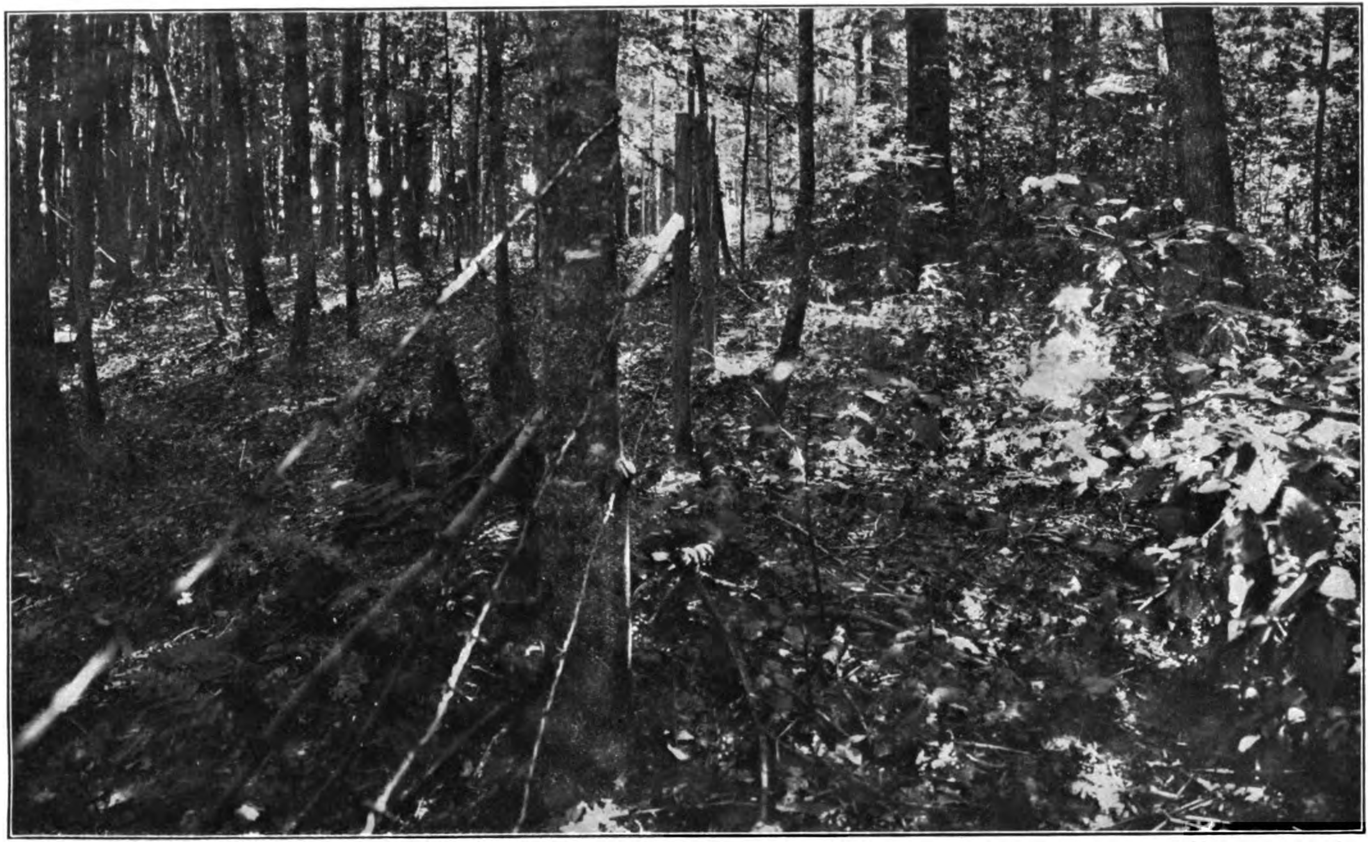


Photo by J. W. Stephen

The Comparison of Natural Reproduction on Pastured and Unpastured Land. To the right of the Fence pasturing has been prohibited, and there is an excellent reproduction, while on the left pasturing has been permitted and no young growth is to be found.

The borers generally work by burrowing under the bark and feeding on the living "cambial" tissue between the wood and bark. Spreading out in secondary channels, these insects more or less girdle the tree, or parts of it, and either greatly weaken the vitality of the tree or kill it.

Perhaps most important of these are the white pine weevil, which destroys the leading shoots of young white pine, thus materially lowering the subsequent value for lumber, as well as greatly retarding growth. Very serious attacks of bark-borers on pine and spruce have in the past killed enormous numbers of these trees, and the pests may reappear at any time.

The hickory bark-borer is another very important pest. The locust-borer has precluded the use over most of the State of what otherwise would be one of the best trees in the woodlot.

The leaf feeders, as their name indicates, injure the trees by more or less completely eating off the foliage, thus greatly checking growth and weakening the tree; and killing it if repeated over several years.

The forest tent caterpillar, attacking principally the maples, the antlered maple worm, and the elm leaf beetle are prominent examples of destructive pests of this kind. The gypsy and brown tailed moths are of this type of insect and constitute two of the greatest plagues which ever attacked the woods. So far they have been kept from obtaining a foothold in this State, and it is hoped to exclude them permanently.

Of the tree diseases not so much is known. Those that attack living trees generally work by feeding on the cambial layer just under the bark, and appropriating to themselves the nourishment which should go into the tree.

Many of these diseases have two stages and more than one form; that is, they may live part of their lives on a certain tree and part on another plant, and the form on the different hosts may be entirely different and not recognized except after careful study.

Thus, one of the most threatening diseases which has appeared in some time has been the white pine blister rust. This disease lives in one form on young white pine and at other times in another form on the currant and gooseberry. Fortunately, the disease has so far been kept in check by destroying all the currant and gooseberry bushes near any infected localities — deprived of its alternate host, the disease cannot spread.

The chestnut blight is perhaps the most virulent tree disease which has ever appeared. No known remedy has yet been found, and the destruction of the chestnut seems imminent.

The liability of certain species to damage from these causes must be understood. Thus, the chestnut bark disease is so virulent in its attack on chestnut as to render it impracticable to favor chestnut as a tree in forest management. Similarly, in many cases the white pine weevil, hickory borer, elm leaf beetle, locust borer, and other insects make inadvisable the favoring of those species in certain localities and under certain conditions.

These must necessarily modify the forest practice, both in selection of species and especially in taking steps to see that the woods are as little liable to attack as possible. This generally means keeping the woods cleared of dead and diseased individuals, as these are the breeding places for the disease or insect. Another important and practicable thing is to protect and encourage the propagation of our insectiverous birds, etc., as these are very valuable in checking depredations.

Poisonous Gases. Poisonous gases, such as produced by smelter works, often will kill all the tree growth in their vicinity. This is of very limited occurrence, however, and not often noted. About the only measure possible in such cases is to use the species most resistant to the poisons found.

FOREST TYPES AND STANDS

It will be seen that a great many factors are at work influencing the growth of the trees. The resultant of all the natural forces operating at any one place is a definite kind of forest growth. This is called a "forest type." These types are distinguished generally by the kind of tree or trees predominating in them, by the situation, etc.

In New York State about twenty-five distinct forest types are found. Most important of the woodlot types are:

1. Mixed hardwoods (oak, chestnut, etc., predominating).
2. Mixed hardwoods (beech, birch and maple predominating).
3. Mixed hardwoods (oak and hickory predominating).
4. Chestnut oak ridges.
5. Chestnut.
6. Old field hardwoods.
7. Red maple and swamp hardwoods.
8. Black ash, swamp.
9. White pine and mixed hardwoods.
10. Mixed pine, hemlock and hardwoods.
11. White pine, pure.

12. White birch.
13. Popple.
14. Pitch pine.
15. White cedar.
16. Red pine.
17. Old field cedar.
18. Waste lands.

Further, as it is generally noted that a certain type may have a considerable variation in its growth conditions, in the habits of the trees, etc., dependent on the quality of the site, we frequently speak of this type as Quality I, Quality II or Quality III.

Detailed description of important types, and best methods of managing them, will be the subject of the second volume of this bulletin.

TERMS USED IN FOREST DESCRIPTION.

In every occupation, when one first enters it, he must learn to know the meaning of the things he sees. He must know what to look for, and where to look for it. In seeking information concerning his work he should know the common terms used in connection with it, in order to be able to describe what he sees, and to understand descriptions of similar conditions.

While it has been the aim of the author to avoid the use of any technical terms whenever possible — and never without giving a clear short description of the meaning of these terms when first used — it is very convenient to use some of these terms. Besides, in the ever-increasing literature on forestry, which the layman now has access to, some of these terms frequently occur. Therefore, it it well to define the most common general terms here, and the less common, but still important, terms, when first used.

Of course, it is not essential to use these terms; but it is just as well, for example, to know and use the term "rotation" correctly in its forestry sense, as it is in general agriculture; it is just as convenient to know what the term "pure forest" means, as "pure bred."

Most of these terms practically explain themselves but are defined here for convenience in further reference. Besides this, the grouping and describing together the terms used most commonly in forest description offers a very satisfactory way of bringing to the reader's attention the principal points to notice in a forest stand.

The terms used in describing trees with regard to the position of their crowns; and the terms "crown," and "forest type" have already been defined. A tree is said to be of seedling origin if it started from seed, in distinction to one starting from sprouts.

PURE AND MIXED STANDS. If over 80 per cent. of a stand is of one species, it is called pure; when less than 80 per cent., it is called mixed. Mixed forests differ considerably in their problems of management from pure forests. Thus, pure stands present no great problems in competition for reproduction of given species with other species; on the other hand, there is no such a variety of material produced, nor is as much produced on a given area by pure stands, as by a mixed stand of species of different requirements as to light, etc.

DENSE STANDS; OPEN STANDS; FULLY STOCKED STANDS. When a stand has just enough trees on a given area so that the crowns of the trees shade the ground completely, it is of full density. When crowded closer than this, the stand is too dense, or overcrowded; when less, it is "open," "very open," etc. When the trees bearing these crowns are all of valuable species; each tree with well proportioned top and trunk, it is said to be "fully stocked with valuable species."

AGE AND REGULARITY OF STANDS. When all the trees in a stand are of about the same age (generally within a twenty-year range, from the youngest to oldest), it is called an even-aged stand; and may then be called a young even-aged, mature even-aged stand, etc. If two distinct age classes are found, it is called "two-aged." If many different age classes are found, it is called "many-aged."

The character of the stand as to age naturally affects its management; as, for example, in a many-aged stand, with young as well as old trees represented, problems of reproduction are different from those in a mature, even-aged stand. The forest is sometimes classified according to the evenness of height in the crown of the stand as a whole: — when all the trees forming the principal crown are of about the same height, the stand is said to be "regular;" when a fairly noticeable proportion are of one height, and the rest are of another uniform height; it is said to be "two-storied;" when still more uneven, it is said to be "irregular."

SIZE OF STANDS. A tree is said to be of seedling size if less than three feet high; a sapling when over three feet high, but less than four inches diameter; a small pole when between four and eight inches diameter; a large pole between eight and twelve inches diameter; a standard between one and two feet diameter; and a veteran when over two feet.

According to the size of the greatest number of trees in the stand, the stand is so designated, for example, a small pole stand.

"Form" of Forest. Besides distinction as to mixture, age and height according to the origin and history of a given stand, it is said to have a certain "form."

Three principal "forms" are noted:

"Seed" or "High Forest" form, where the stand has originated from seed.

"Sprout" or "Coppice" form, where the origin was from sprouts.

"Mixed Seed and Sprouts" or "Composite" form, where the origin was from sprouts and seedlings.

These terms will be better understood after reading the section on Cuttings for the Production of New Stands.

In describing the forest, its relation to all the factors of growth noted before should be given, as well as notes on the condition and character of the stand as a whole, and of important facts concerning the trees themselves.

The following form will serve as a useful guide in examining and describing a forest stand.

NEW YORK STATE — FOREST TYPE DESCRIPTION

Owner's name.............................. Examination No..............
County.................. Town.................. Date.................
Forest type........ Per cent. of this type in woodlands of the district.....
Origin ....
Quality of site (first, second, third)..................................
Soil (kind and depth)..
Underlying rock..
Soil moisture conditions...
Elevation ....
Elevation above drainage level of district.........................
Exposure ....
Slope ....
Quality of stand...
Condition of stand...
Form ....
Diameter classes. (If several, give proportion of each)................
....
Height of average tree in each diameter class.........................
....
Average tree: Height.......feet. Diameter.......inches. Age.......years.
Density ....

HISTORY

Past use and management..

....

Damage and protection..

....

Stand per acre. (Total each kind merchantable material).................

....

Stumpage value per acre..
Growth . . ..
Composition . . ..
Complete list of all kinds found (Give per cent. of each important species over two inches D. B. H.)

....
....
....

Reproduction on ground. (Relative amount each kind)..................
....
....

Undergrowth and ground cover.....................................
Best species for management......................................
System of management advised.....................................
....
....
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III. APPLICATION OF FOREST MANAGEMENT

A Detailed Discussion of Practical Methods

PROTECTION

The first thing to attend to in forest management is to provide protection from damage. As noted before, the principal damage comes from fire, grazing, insects, diseases and wind. To these might be added the harm done by careless cutting and logging, in which many trees are seriously injured or killed. This, however, will be discussed under the head of " Cuttings."

Preventing and Fighting Forest Fires.* In protecting from fire, the most effective means are *watchfulness* and *care:* —ever watchful to discover fires as soon as they may start, that they may be fought immediately and *watched until completely out;* great care in the use of fire near the woods, and in guarding against conditions that make it easy for fires to start and spread,— and thus, of course, difficult to control. In the woodlot the ground should be kept cleared of inflammable material. Dead and fallen wood should be cut up, and as much of it as possible used, and the brush should be made to lie flat on the ground so as to rot quickly. Where the danger from fire is especially great, this brush should be burned. Burning of waste in tops, etc., should be done at the same time as the regular cutting — preferably in winter. All that is needed is to make a good bed of hot coals from dry material and then there is no trouble in burning the rest. Where this work has had to be paid for in lumbering jobs, it has been done for twenty-five cents per thousand feet of lumber cut. Ploughed furrows, exposing the mineral soil, make good checks against fire.

In larger bodies of woodland, it is essential to have clean roads and trails to stop any fires which may occur. These should exist at not too frequent intervals (not over one-quarter of a mile apart), and can generally be maintained with very little trouble, and practically no expense, by thoroughly cleaning out existing roads and trails. Where this work must be paid for, it seldom will cost over

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* Bulletin No. 10 of the Conservation Commission deals with the subject of " Forest Fires," and should be carefully studied wherever special methods are necessary to secure protection from fire.

$10 a mile; and generally considerably under that. Cultivated strips, sown to oats, etc., sometimes are advisable.

In such larger bodies of woodland, co-operation with adjoining owners is necessary to secure protection. It is impossible to protect your holdings properly, if in adjoining woodlands no protection is given.

Your neighbor probably wants to protect his woods as well as you. If not, have him understand the provision of the law, and the penalties for negligently allowing fires to extend from his land to that of another.

A Wood's Road.
Such roads should be kept clean; and then are of great value in fighting forest fires.

Should a fire start anywhere in a district, it is essential to be so organized that it should be immediately discovered; and fought as soon as discovered.

In districts of extensive woodlands, and sparse settlement, a regular patrolman on the lookout for fires may be advisable. In other cases, where some commanding peak gives a view of a large territory, it often is best to maintain an observer on that point; and provide telephone communication to it, so that immediate warning of any fires which may start should be given.

Only too frequently a fire is allowed to burn because it is thought that it will do no damage. This is a mistake. In the first place, there is always the danger of the fire growing to larger proportions where much direct damage will result; and in the second place, there is always secondary damage, as noted under the effects of fire on the woods.

In fighting fires, if small, the best way is to beat out the fire with brush, wet gunny sacks, etc., or by shoveling dirt on to them, especially in a sandy district. Often, if water is handy, a common bucket spray pump is very useful.

Always attack the front of the fire, leaving the sides to later consideration, and the rear till last; and *never* leave the fire *unwatched* until it is completely out.

When the fire is too large to beat out, backfiring is resorted to. This consists in starting a fire under control, sufficiently in advance of the main fire, to burn back to it, against the wind, and thus for both to burn themselves out. Great care must be taken not to allow the back fire to get beyond control and thus start a main fire of its own. The backfire should be set from some existing road or trail, or by raking up a line of leaves toward the main fire; setting fire on the side toward the fire, and beating out any sparks which may " jump " the line so established. The backfire line should be patrolled until danger from fire is over.

Great judgment is needed in determining how far in advance of the main fire it is necessary to go to start the backfire, without burning unnecessarily a large area of woods.

Other methods, in special cases, are necessary, but these suffice for the great bulk of woodlots.

Do not burn brush adjoining your woodlot, nor allow your neighbor to, when the ground is very dry, when a high wind is blowing, etc.

See that railroads comply with the law requiring them to keep their rights of way clear of inflammable material. Along roads, railroads, or other places, where risks from fire is especially great, it may be advisable to burn over a strip sufficiently wide to protect the rest of the wood lot. Thus, along a public road, burning a strip from ten to twenty feet on each side of the road will greatly lessen the chances of fires being set by people carelessly throwing away lighted cigars, matches, etc.

In doing such work, however, it is important to take every precaution that the fire should not spread into the main body of the woods. The leaves should be raked toward a road and fires set when the woods are just barely dry enough to burn. Several small fires should be started, and watch kept until they are completely out.

This latter provision applies to the case of all fires set in or near the woods; — always be sure that a fire is out before leaving it; and never start one, or allow one to burn, under conditions in which there is a good chance of its getting away from control. It is worth while to know the law regarding forest fires.

LAWS RELATING TO FOREST FIRES.

From the standpoint of the law affecting forest fires, two sharp divisions of the State are noted — the " fire towns," and the rest of the State.

THE FIRE TOWNS. In one division, embracing the so-called fire towns, many special provisions of law, and an entirely different condition, with regard to fire protection, and fire fighting, is found from those existing in the other. This division, as shown on the accompanying map, embraces the largest part of the Adirondack Forest Region and part of the Catskill Forest Region.

Roughly this covers about 7,000,000 acres of land in all, and embraces about 6,000,000 acres of forest.

In this division the State maintains a thoroughly organized system of fire patrol, including watch towers with observers stationed permanently on them during fire seasons; forest rangers to patrol the district, and look after the immediate problems connected with any fire which may occur, and fire wardens, who are responsible men, stationed at every advantageous point, to take charge of fighting fires in their immediate vicinity. To supervise this force, five district forest rangers are in charge, each of a given district, and general supervision of the whole is under the State Conservation Commission.

Here the State not only pays the entire regular protective force, but also one-half the cost of fighting any fires which may occur. Here also, it is not left to local people, and often indifferent town officials, to determine whether they will appropriate money to fight forest fires, as the State pays the whole bill, and collects half from the towns.

In addition to this organization, many special provisions of law are enforced. Thus, it is illegal in these towns to burn brush, stumps, logs, etc., without first obtaining the written permission of a district forest ranger, or of the nearest forest ranger, who must be personally present when the fire is set, if the fire is near forest or woodland.

On lumber jobs the lopping of tops is required, thus greatly lessening the danger from this very common source of fires.

Railroads and Forest Fires. Railroads within these towns are required to burn oil in their engines through the day so as to lessen the danger from fire so often set by the coal burning engines.

The railroads through the forest preserve must, at their own expense, organize and maintain a competent and sufficient fire patrol to protect the forest from fires, and, if they do not do so, the State Conservation Commission may organize a patrol and collect the expenses thereof from the railroad.

In the 1912 Legislature a law was passed giving the Conservation Commission power to compel railroads to organize such patrol outside of the fire towns operating through any wooded or forest lands, and where the danger from fire warrants it.

In any part of the State, the company or person operating railroads or logging roads, must, on such part of its road as passes through forest land, or land subject to fire from any cause, cut and remove from the right of way along such lands all grass, brush or inflammable materials, whenever required by the Commission.

Each locomotive shall be provided with efficient spark arresting devices, and devices adequate to prevent the escape of fire from ash pans and furnaces.

The State Outside of the Fire Towns. Aside from these general laws affecting railroads through forest lands, the areas outside of the fire towns, are practically neglected by the State so far as the forest fire situation is concerned. This division covers about 23,000,000 acres of the State and about 6,500,000 acres of woodland, including the whole or part of six areas in which the forest cover is more or less continuous, where the danger from fire is very great, and where protection, without a large thoroughly supervised organization is difficult, if not impracticable.

In all these other towns the town supervisor, by virtue of his office, is superintendent of fires in his town, and charged with the duty of preventing and extinguishing forest fires. He has the power to employ persons to act as forest rangers in preventing and fighting fires, and to employ the necessary assistants therefore, and has all the power and duty conferred upon the Conservation Commission, District Forest Ranger, Forest Ranger and Fire Warden in the fire towns. Any person summoned to fight forest fires who is physically able and refuses to assist shall be liable to a penalty of $20. The town board of each town shall at its first annual meeting designate one of its members to act as such superintendent of fires for the ensuing year in case of the absence of the supervisor. The town board shall fix the compensation of all forest rangers and assistants employed under the provisions of this section; and all expenses incurred under the provisions of this section shall be a charge upon and be paid by the town.

It is thus seen that the question of providing protection from fire in these districts is entirely a town matter.

In most of the towns this, of course, is as it should be. Where the woodlands are unevenly scattered pieces attached to each farm, and where the greatest source of danger comes from the individual owner of the woodlot, or from his neighbor, or, perhaps, from railroads, it is for the individual owner, his neighbors and the town to keep the fire out. When, however, the woodlot is in one of the forest regions of the State where hunting and fishing is common, and where there is but very little settlement to break a fire, and few people to fight it, this condition is unfortunate, and has proved entirely ineffective to meet the conditions and prevent forest fires.

However, it is well to know that the courts have ruled in the case of town supervisors, who, when informed that fires are burning in the woods, fail to organize a force and go out and fight the fire, that that supervisor shall be personally liable for any damages which may be done to any individual who suffers damages after notifying the supervisor.

There are certain general laws with regard to setting fires in the woods which it is well to know.

Chapter 474 of the Laws of 1910, provides that any person who, under circumstances not amounting to arson in any of its degrees:

(1.) Willfully burns or sets fire to any grain, grass or growing crop, or standing timber, or to any building, fixtures or appurtenances to real property of another, or

(2.) Willfully sets fire to, or assists another to set fire to any wild, waste or forest lands belonging to the State or to another person whereby such forests are injured or endangered; is guilty of felony and is punishable by imprisonment for not more than ten years or by a fine of not more than two thousand dollars, or by both.

In Chapter 444 of the Laws of 1912, the following general laws, with regard to setting fires, are found:

In section 98 it is provided that any person who sets fire to waste or forest lands, except as especially provided for in the fire towns where burning must be done under permit and the supervision of the forest ranger, or who negligently suffers a fire to extend from his own land to any other lands whereby property is damaged to the value of $25 and upwards, is guilty of a felony; if less than $25 is guilty of a misdemeanor. Such person shall also be liable to the State for any damages caused to State land by such wrongful act, and to a penalty of $10 for each and every tree so killed or destroyed, and shall be liable to any person or municipality for any damages caused to such person or municipality by such wrongful act, and the person or municipality so injured, however distant from the place where such fire was set and notwithstanding the same may have burned over and across several separate and distant tracts, parcels or ownerships of land, may, at his option, sue for and recover actual damages, or damages at the rate of $1 for each tree killed.

Damages to State lands shall be ascertained and determined by the value of the timber thereon, taken at the value the said timber would have, if the said lands were owned by private individuals.

The fact that any fire started on, or extended over from lands or right of way owned or leased or used by any railroad company, or by any other person using, manufacturing or producing any coal, wood, oil or other fuel or any inflammable material thereon for other than domestic purposes, shall be *prima facie* evidence that the said fire was set or started thereon, or suffered to extend therefrom, by the willful negligence of the said person or railroad company.

Any moneys necessarily expended by the State, municipality, or other person, in fighting fires upon waste or forest lands may be sued for by the State, municipality, or person expending the moneys, and recover from the person causing the fires as simple damages, in addition to the damage or damages at the rate of $1, and in addition to the penalty or penalties of $10 for each tree killed, provided for as aforesaid.

Section 99 provides the following penalties for setting fires in the woods:

Every person who shall kindle a fire on or near forest or brush land and leave it unquenched, or be a party thereto, or who shall set fire to brush, stumps, dry grass, field stubble or other material on or near such forest or brush lands and fail to extinguish the same before it has endangered the property of another; every person who shall negligently or carelessly set on fire, or cause to be set on fire, any woods, grass or other combustible material, whether on his own land or not, by means whereof the property of another shall be endangered, or who shall negligently suffer any fire upon his own lands to extend beyond the limits thereof; every person who shall use other than incombustible gunwads or carry a naked torch, firebrand or exposed light in or near forest or woodland, or who, in the vicinity of such land, shall throw or drop into combustible material any burning match, ashes or pipe, lighted cigar or cigarette, or any other burning substance, and who fails to immediately extinguish the same, and every person who shall deface, destroy or remove any law, rule or notice posted under this chapter, shall be guilty of a misdemeanor punishable by a fine of not less than $10 and not exceeding $25 and costs of prosecution, or by imprisonment in the county jail not exceeding ninety days, or by both such fine and imprisonment.

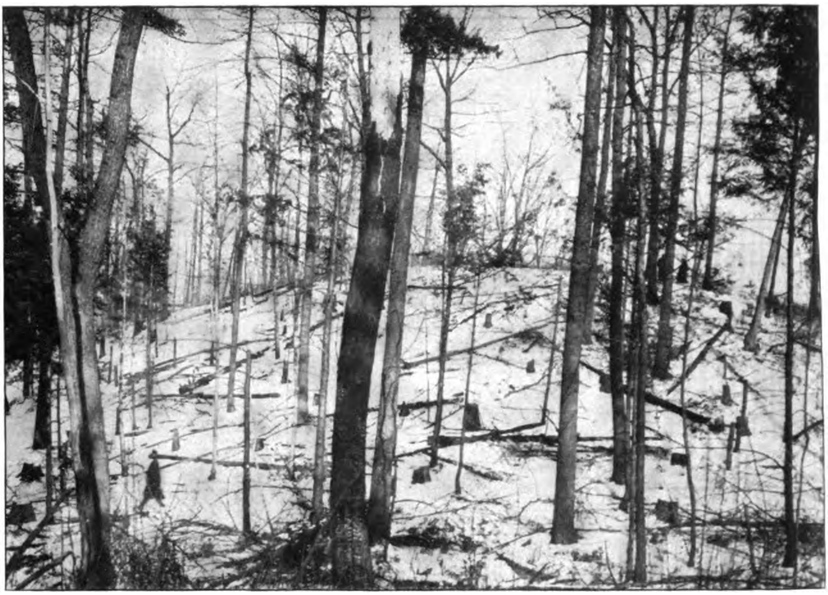
Section 100 provides that every person who starts a camp or other fire upon or near forest or woodland shall before lighting the fire clear the ground of brushwood, etc., within a radius of ten feet, and shall carefully extinguish the fire before leaving the place. Any person violating the provisions of this section shall be deemed guilty of a misdemeanor, and punishable by a fine of not less than $10 or more than $25 and costs of prosecution, or by imprisonment in the county jail for not more than ninety days, or by both such fine and imprisonment.

Of course, most would be done anyway, law or no law, by taking effective means along lines suggested before to keep the woods cleared of inflammable material; to keep clean roads and trails from which to fight fires; to limit their spread by the watchfulness of the individual owner, and by co-operation with adjoining neighbors.

Forest fires can be prevented, and without such great trouble or expense as is anticipated by most persons.

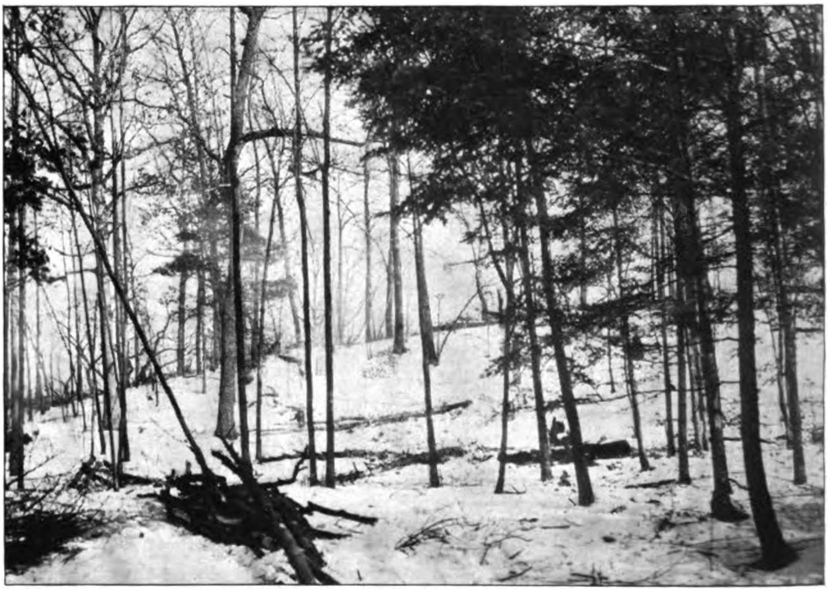
When people realize the damage which fires, even though light, do to the forests, and, also, the fact that a little preparation, a little care, and a little co-operation with others, well mixed, with a strong sentiment in the district against forest fires, will provide an effective preventative, the end of forest fires will be in sight. To this should be added some more effective and progressive legislation.

Protection against Grazing. Grazing should be excluded as far as practicable. It should be allowed only where the trees are of fair size, and then only for a short time, and never should be permitted when there is a new growth of seedlings or sprouts on the



Cuttings to Remove Dead and Down Material.

Neglect, and poor and wasteful methods, have produced this result. Besides waste, this condition makes forest fires easy to spread and hard to check.



Cleaning Up the Dead and Down Material.

Firewood, fenceposts, and even logs, are often secured, and more than pay for the work, besides improving conditions.

ground. It may be advisable to graze a mature woodlot just before the seed falls from the trees in a good seed year, in order to stir up the ground and make the conditions better for the germination of the seed.

Protection against Insects and Disease. The same work that is advisable for protection of the woods from fire — that is, the cleaning up of dead and fallen material — is the best step to take against insects and disease. This should go farther, and all trees of low vitality should be cut unless there are some special reasons against doing so.

The methods, such as spraying, applicable in orchards, and with street and park trees, are too costly to be practicable in the woodlots. Reducing the chances for those enemies to establish themselves; favoring such natural checks as insectiverous birds which feed on these pests; and watchfulness and care, are the best means of controlling these enemies.

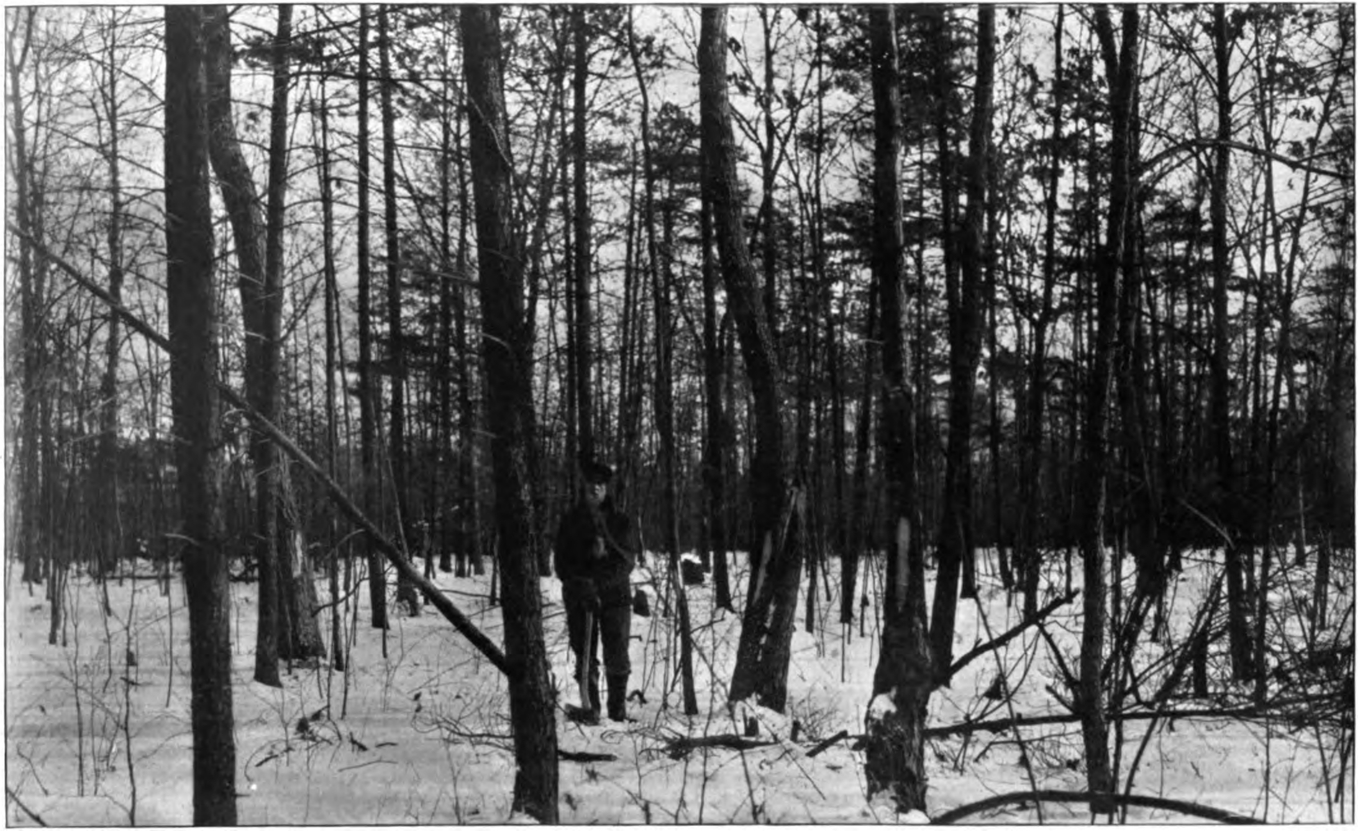
Wherever any trees are affected by some particularly dangerous enemy, special watch should be kept, and these trees cut as soon as the presence of that enemy is detected. As an example, if the white pine blister rust should be noted on any tree, that tree should be immediately destroyed. It is possible that with the chestnut bark disease, in regions where the disease is not common, that cutting of infected trees, as soon as they appear, may hold the disease in check.

Such methods are more effective against the boring forest insects than against other insects or fungous diseases; and if infected trees are cut, and the bark burned, if necessary, the danger from the insect attack may be obviated.

The number and kinds of these insects and diseases are great, and each one has its special features, making it far too detailed to describe them here. Whenever any special attack on any kind of tree is noted, specimens should be sent to this office, and advice will be given as to the methods of combating it.

CUTTINGS FOR THE BENEFIT OF EXISTING STANDS

In the woodlot, many systems of cuttings as described in technical works on forestry are impracticable, because of the small area to be dealt with, and the need for wood products every year. At the same time there is always one given system which best meets the demands made upon the woodlot. This one system is practically never put into practice on any given woodlot.



Improvement Cuttings.

Trees marked for cutting, with the purpose of improving the condition of the stand by the removal of the marked trees. At the same time, will secure reproduction of good species, as in selection system of cuttings.

Cuttings to Remove Dead and Down Material. As a matter of fact, in nearly every woodlot the first effort should be to use material lying on the ground which is going to rot and waste. This material generally comes from waste in previous cuttings, or from wind thrown trees, etc. The general practice in the past has neglected to use this material.

Often where the market for cordwood is poor, or too distant to reach, such wood can be burned for charcoal, and thus profitably marketed.

Next should come the cuttings of all standing dead trees, or those which are nearly dead.

This simple rule will often cover the work of cutting in most of our woodlots for the first year or two, as neglect along these lines has been the rule in the past. A thing to remember in all cuttings is to use every bit of material which can be used.

Avoid Waste. This means cutting low stumps, and working tops and large limbs into posts, cordwood, etc. This increases profits and leaves the woodlot in better shape. Avoid leaving a slashing of debris to lie on the ground as a fire menace. In all cuttings, or other woods-work, great care should be taken not to injure any trees which are to be left as part of the next stand. With only a little extra care, and practically no expense, cutting and hauling can be done with practically no injury to the remaining growth.

The next step is to make improvement cuttings for the sake of the remaining stand.

Improvement Cuttings. Improvement cuttings are those made with the primary purpose of improving the character and growth of the remaining stand. This is very frequently the real nature of all cuttings which can be made in the woodlot today, on account of the run-down character of the ordinary woodlot.

Just what might be called an improvement cutting, and what a reproduction cutting, under some of the systems to be described later, would be rather an object of technical discussion, than a matter of great value to the carrying out of a wise and natural scheme of cutting.

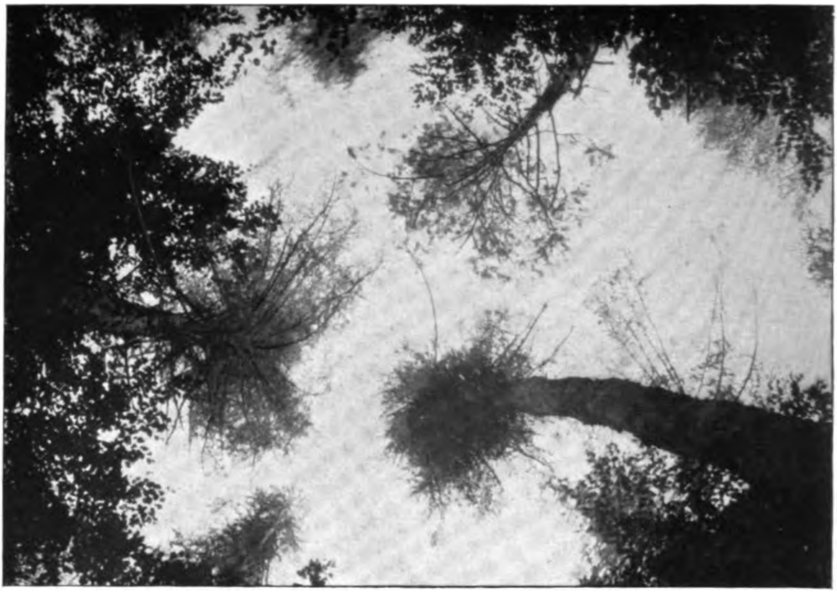
In the cutting of any immature stand, the following principles should serve as a guide:

First. To cut so as to favor the better species, and to remove undesirable species, so far as possible.

Second. To favor the best individuals of the good species, especially removing any which show signs of serious disease or insect attack.

Third. To provide the best conditions of growth for the remaining stand, so that the growth, yield and value of the stand shall be increased.

Of course, where the cuttings would take out a large over-mature spreading tree for the sake of allowing new growth to come in, we might say, technically, that it would be a reproduction cutting, as far as that one tree is concerned; but as a general proposition, the improvement of the woodlot is the main thing to be aimed at in cuttings for some years ahead.



Guides for Improvement Cuttings.
Look up and study crown cover. Only enough should be cut so that crowns of remaining trees will come together in about five years.

Besides improving conditions with regard to kinds of trees favored, there is another important factor in making any cuttings in the woods which always must be borne in mind, namely, the improvement of the general conditions affecting growth; that is, with regard to moisture, light, heat, soil, and wind. At no time should the stand be opened up so as to allow grass or weed trees to take possession of the land. Although we may have a large spreading tree occupying more land than it should, if its position is such, that cutting it will not be followed by reproduction, or if the opening will not be planted up with better trees, it would be better to leave that tree growing, and keep the land shaded, than it would be to cut it. This is a very common problem in the woodlot. The best solution is always to cut out the tree, and plant up the opening with first class seedling stock.

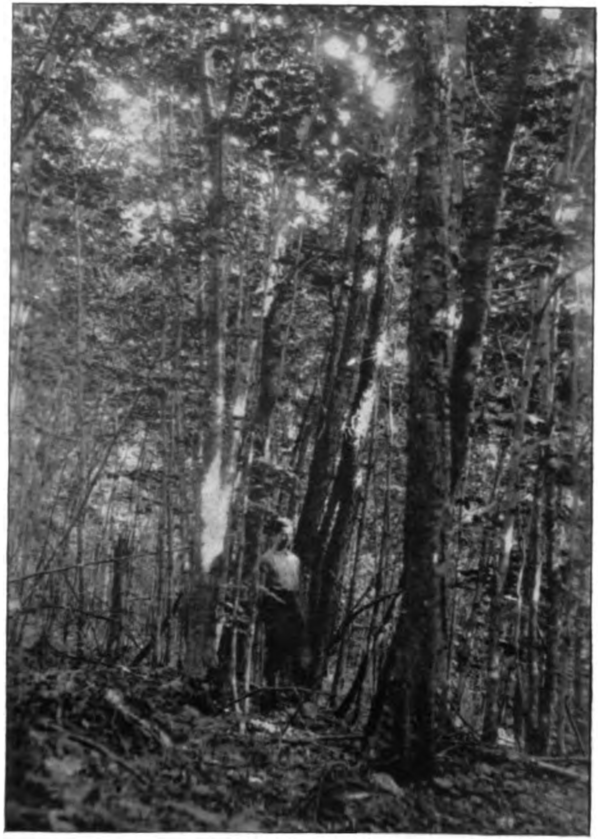
Again, on the border of the woods a fairly dense thicket should be maintained so as to exclude wind from the rest of the woodlot. This may involve leaving undesirable individuals for a period longer than they otherwise would be left, but the conditions would demand their gradual removal.

Improvcement Cuttings in Very Young Stands — Cleanings. Improvement cuttings may start in very young stands, even though no direct return is secured in the work. These would only be justified in cases where distinctly better conditions can be secured.

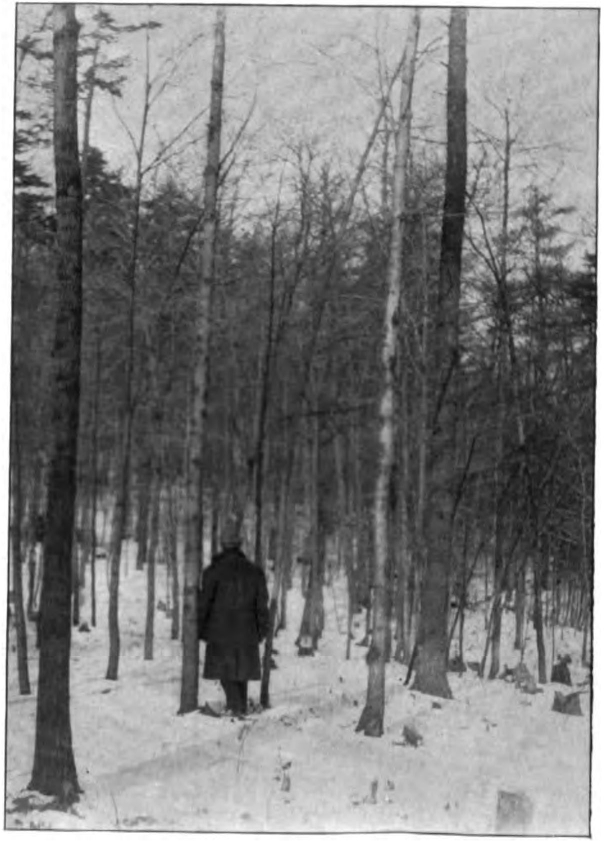
Often pine or seedling oaks, hickory and other good species are overtopped by poorer species, or by the more rapid growing new sprouts. The overtopping of seedlings by sprouts is very common in our woodlots. Again even where sprout growth is of desirable species, often too many sprouts will come up from the same stump, so that there will not only be too much crowding, but there will not be enough nourishment available for all. By favoring the best one or two sprouts, and lopping off the rest, much benefit will result. Often too dense natural seeding takes places, especially in the case of white pine. Where these stand closer than four by four feet, and the trees are over six feet high, conditions would be improved by removing some.

Young Stand in Need of Cleaning.

By going into a very young stand, a brush hook may be used to lop off the growth to be removed; a heavy long-bladed knife, like the South American bolo, is very handy for such work. This can easily be done in the winter time; but should not be done when there is enough snow on the



Stand in Need of Thinning.



Stand After Thinning.

ground to prevent seeing the seedling reproduction. If possible, it is often advantageous to clear out the undesirable sprouts during the late spring or early summer, as then new sprouts will not start from the stumps, while if done in the winter, the work may have to be repeated.

Improvement Cuttings in Older Stands — Thinnngs. In almost all stands containing merchantable sized trees, at least in some places the stand will be too dense, so that the best growth will not result. A given area of land can produce just so much vegetable material in a given time. When this amount of manufactured vegetable matter all goes into valuable individual trees, the real value produced is much greater than if part of it goes into worthless ones. Thus, to reduce the overcrowding, " thinnings " are made in such stands.

Types of Thinnings. There are two general types of thinnings. In the first, or German method, the idea is to remove those trees which have already lost their place in the competition. Suppressed trees are taken first, and the intermediate and codominant trees next, according to circumstances. The dominant trees are not cut unless defective, or of exceptionally poor form. In this method, it will be noted that the principal object is to remove, beginning with the poorest, those trees which are absorbing plant material, but which are already behind in the competition.

In the second or French method, the idea is to select the number of trees, properly spaced, which it is calculated will be necessary to make a full stand of mature dominant trees at the end of the rotation, and give these the right amount of light and space required to grow most rapidly into the kind of products desired. This often requires the cutting of some of the best trees — *dominant and codominant* trees — rather than of intermediate and suppressed trees, in order to secure the proper spacing and species. Suppressed trees, where these stand below the trees selected for the final stand, are not cut unless dead or dying.

The latter method is applicable in places where market conditions are too poor to warrant the cutting of smaller material, and yet where the improvement of the stand is desired. However, in the ordinary woodlot, such suppressed material can generally be used for fuel, etc., and would better be cut unless it would open up the stand too much. Where it will not open up the stand too much, such cutting will give a chance for reproduction to take place, although this would not be the primary object in making the thinning.

In making thinnings the amount of material should seldom exceed 20 per cent. to 30 per cent. of the total stand at any one cut. For the woodlot it will be best to confine the thinnings to the amount which can be profitably used.

In sprout stands it is very desirable to reduce the number of sprouts not to exceed three to a stump, and best, if the condition of the stand warrants it, to only one to a stump.

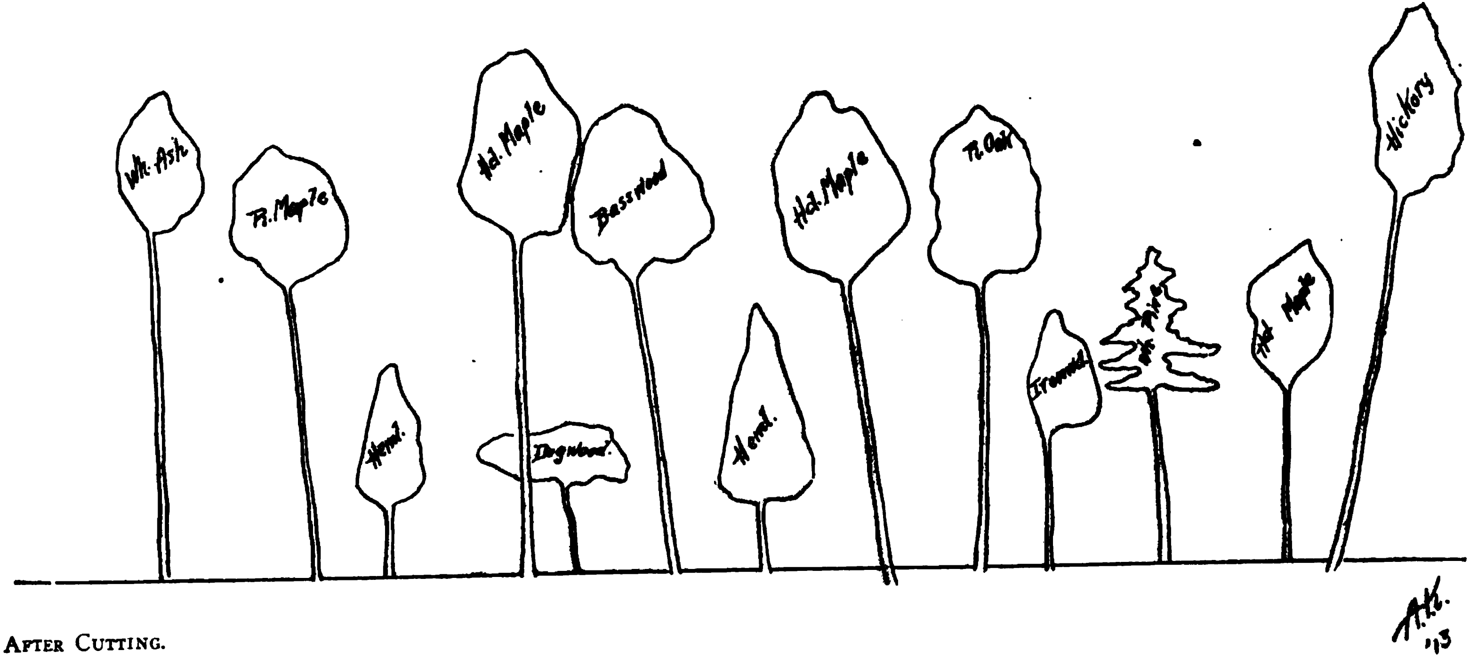
Thinnings should generally be made, so that within five years after the time of thinning, the crowns of the remaining trees will again have closed, and once more completely shade the ground. The thinnings, as noted before, are very closely allied to some of the cuttings for the production of new stands, which will be described later. As a general rule, however, almost every woodlot requires some thinning in connection with the primary improvement cuttings in order to get the woodlot into good shape.

It will be remembered that the first cuttings, rather than attempting to secure correct spacing or even the proportionate increase of better species, must aim first at improving the whole general health and thrift of the stand, selecting first dead and dying trees of any kind, and those infected with disease or dangerous insects, and so on up to the highest grade of cutting made purely for the improvement of the growth of individual trees.

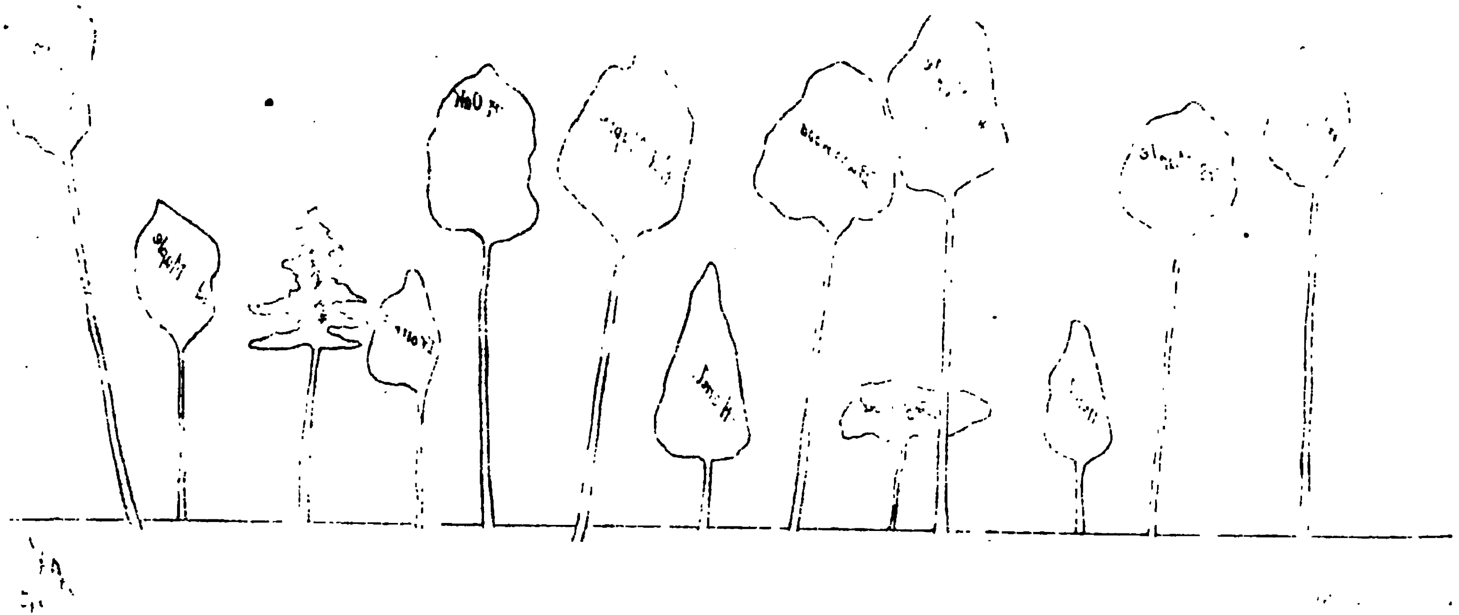
Results of Thinnings. Measurements made in stands which were properly thinned, have shown an increased growth of as high as 34 per cent., following such thinnings.

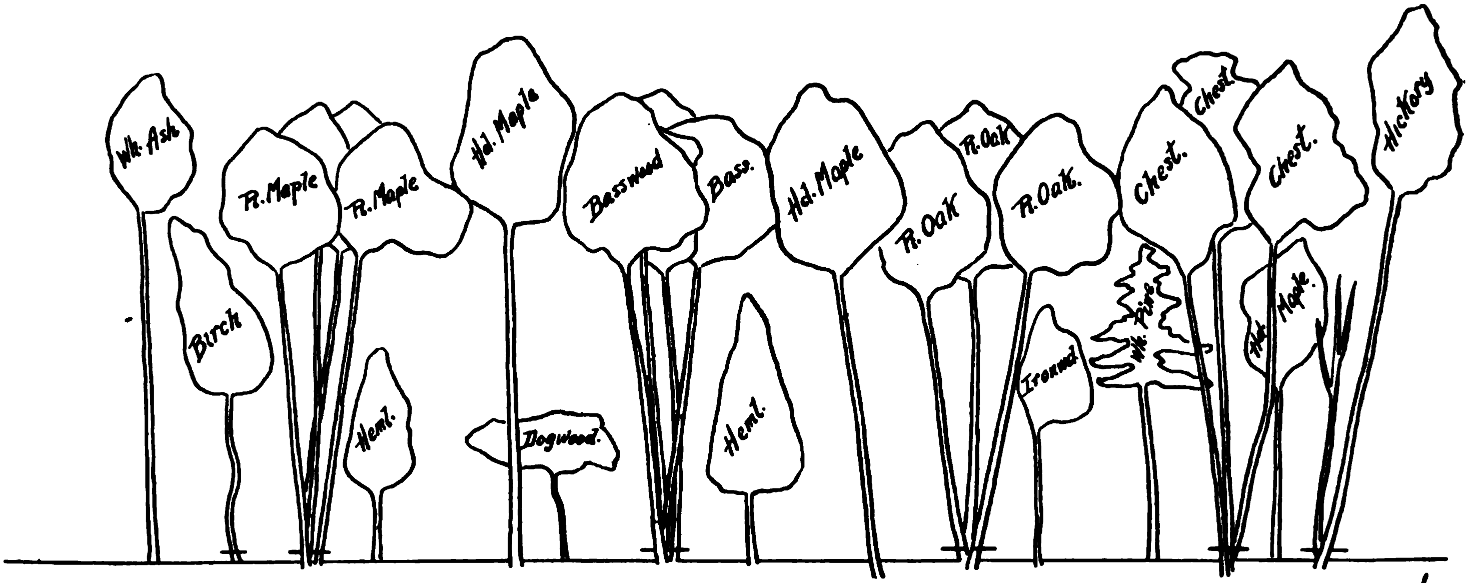
That some concrete idea may be had of what is cut in thinnings at different ages, the following table is given. It shows the average number of trees per acre found in stands of different sizes of well stocked, but unmanaged hardwood woodlots, and the number which should be left after a thinning. These figures are merely an index, and must of course, be modified in each special case.

Diameter Breast high of average tree	Average number trees per acre in well-stocked unmanaged stands	Maximum number trees per acre to be left after thinnings
3 inches or less	1000–1200	800–1200
4 inches	800–850	600–700
5 inches	600–700	400–550
6 inches	475–550	300–450
7 inches	350–475	250–300
8 inches	325–400	200–300
9 inches	300–350	200–250
10 inches	250–300	175–225
11 inches	225–275	150–200
12 inches	200–250	125–175
12 (over)	....	100–150



After Cutting.



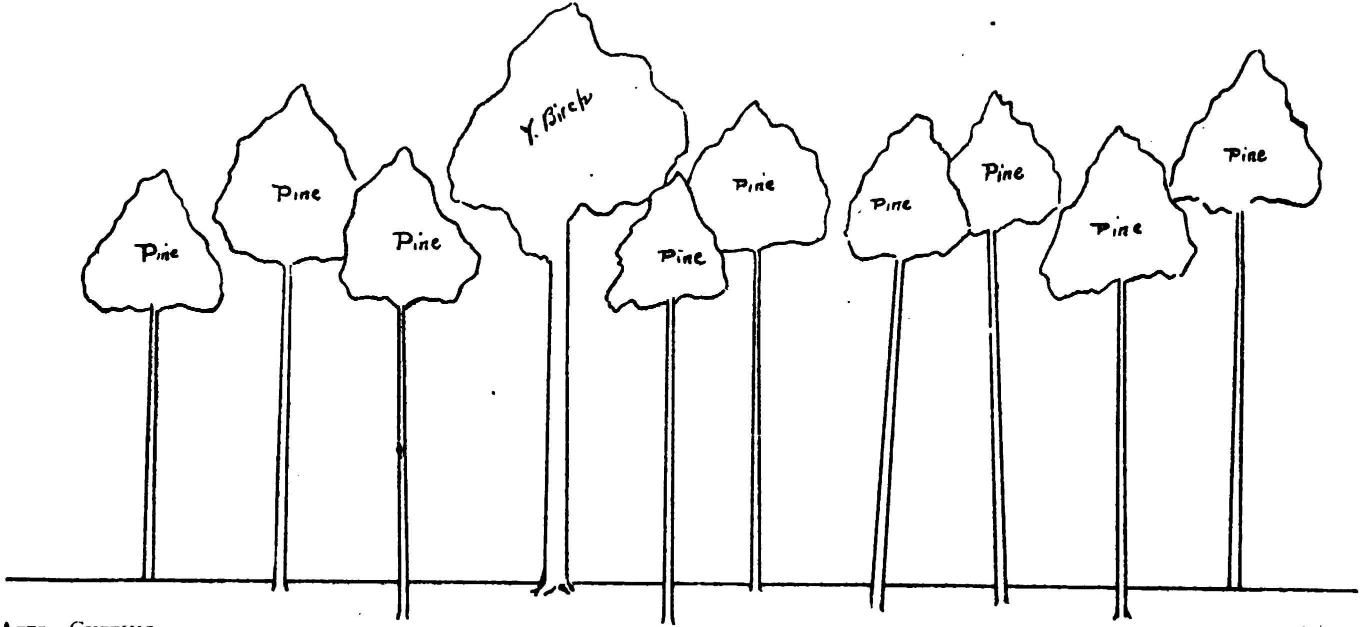


BEFORE CUTTING.

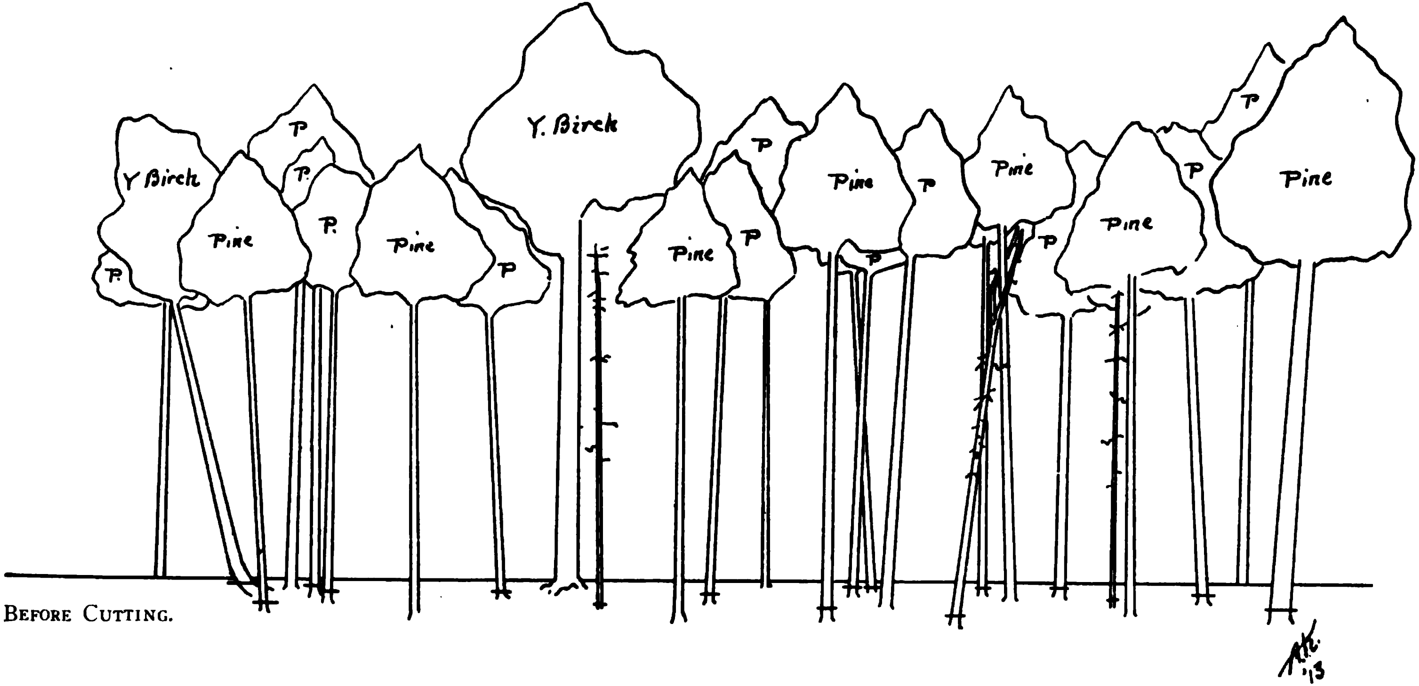
A.K. '13

MIXED HARDWOOD SPROUT STAND, WITH HEMLOCK AND WHITE PINE IN MIXTURE.

All too crowded; the chestnut dying from the chestnut bark disease; red maple a decidedly inferior species; and too many sprouts to the stump. After cutting, there remains an improved stand, both as to species and spacing. The ironwood and dogwood might have been cut out, but are not crowding any valuable species and were too small to pay for cutting.



After Cutting.

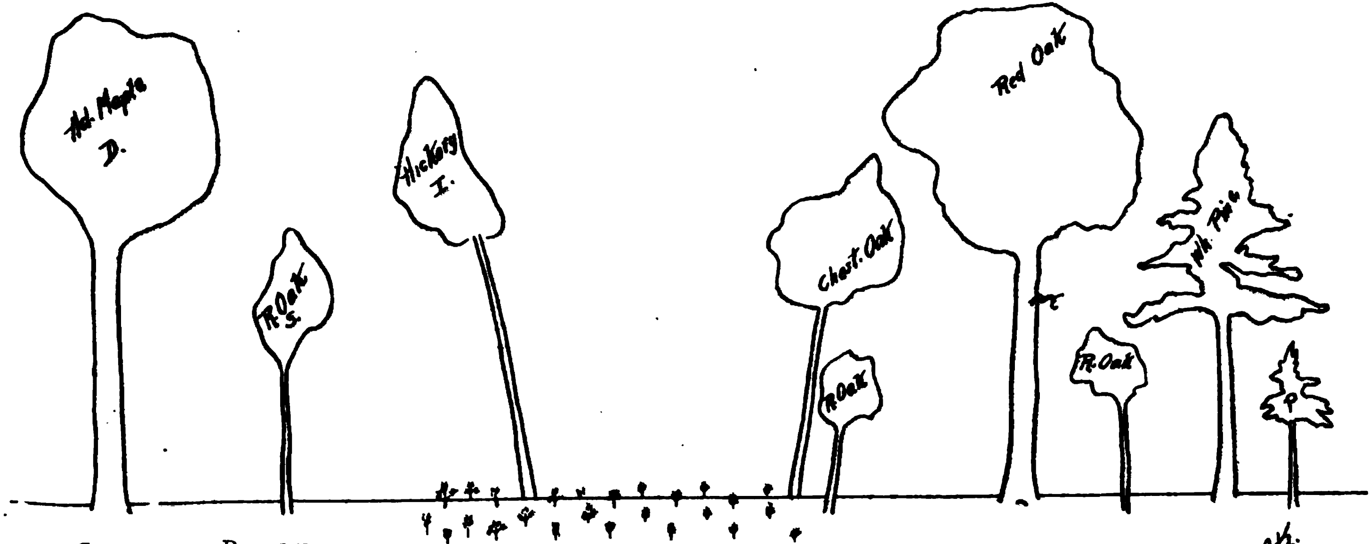


Before Cutting.

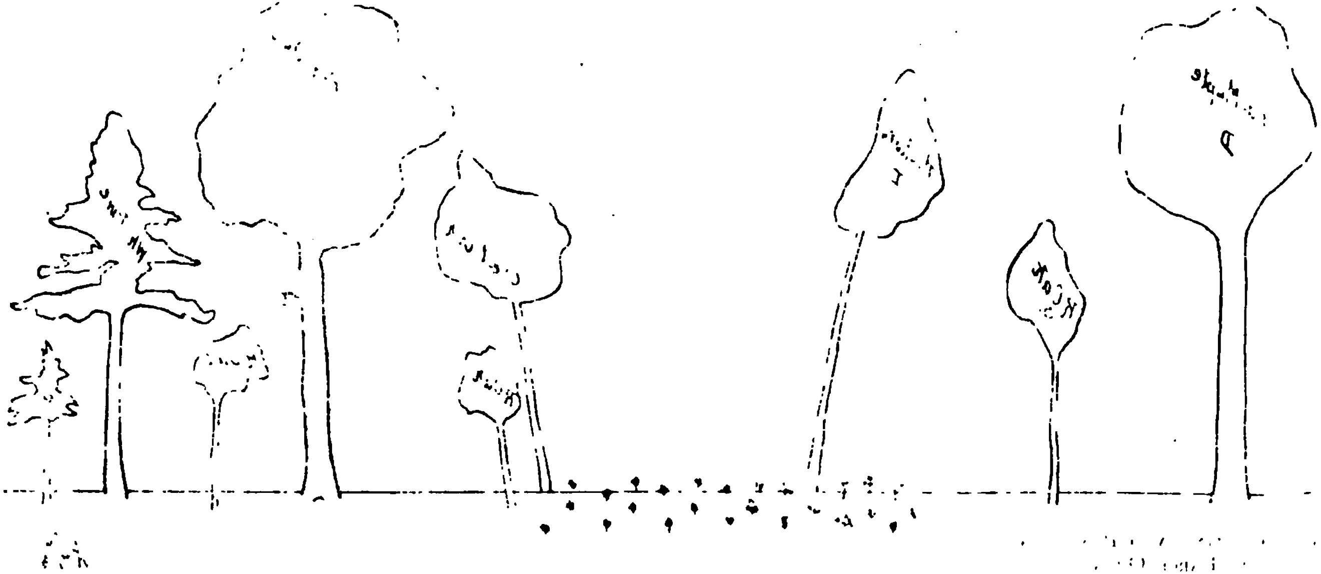
White Pine Grove.

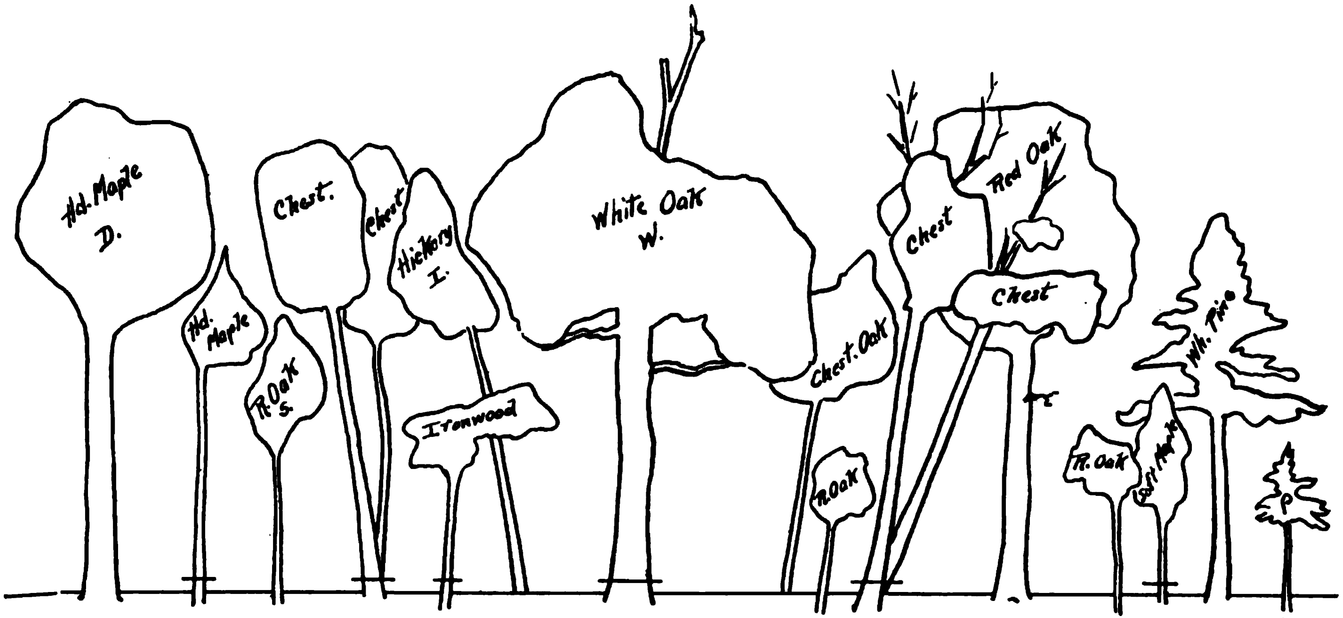
Stand Far Too Crowded, Checking Growth.

Several trees already killed out by the competition. After cutting, all the trees left will be able to go ahead rapidly, producing more in value than before, in addition to the yield of the present cutting.



After Cutting and Planting of the Large Opening.

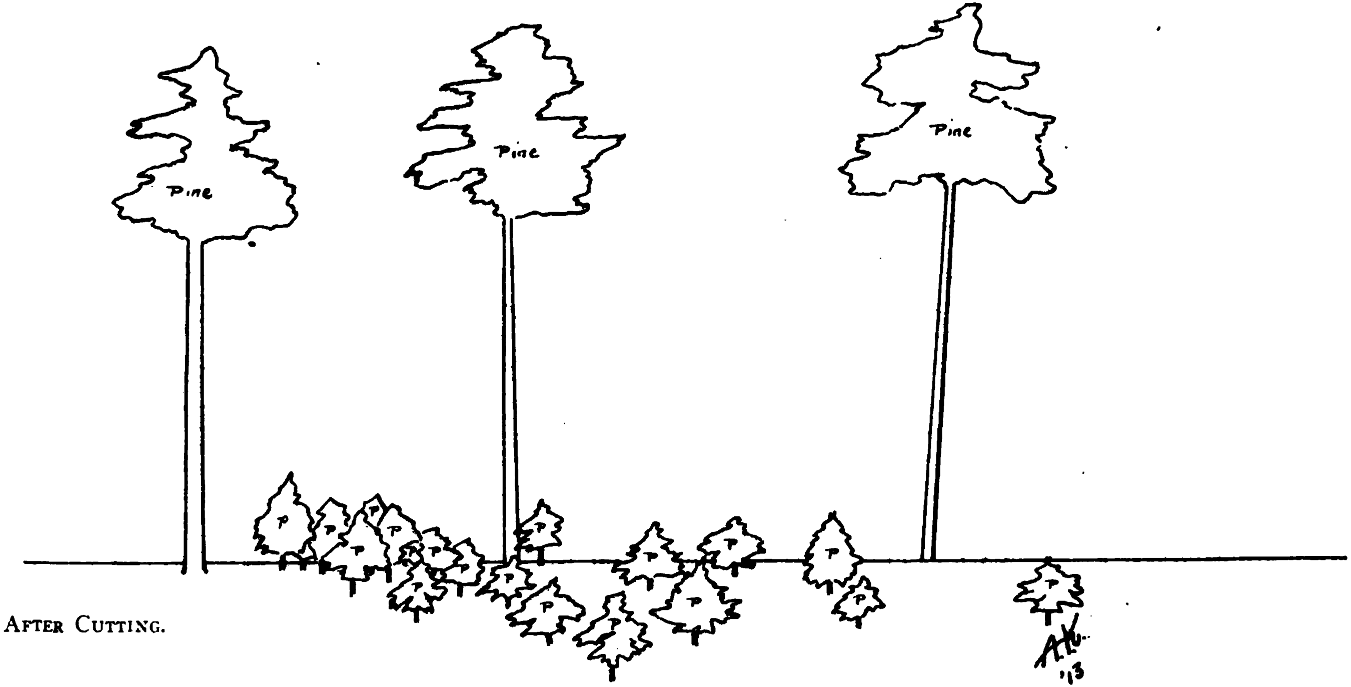




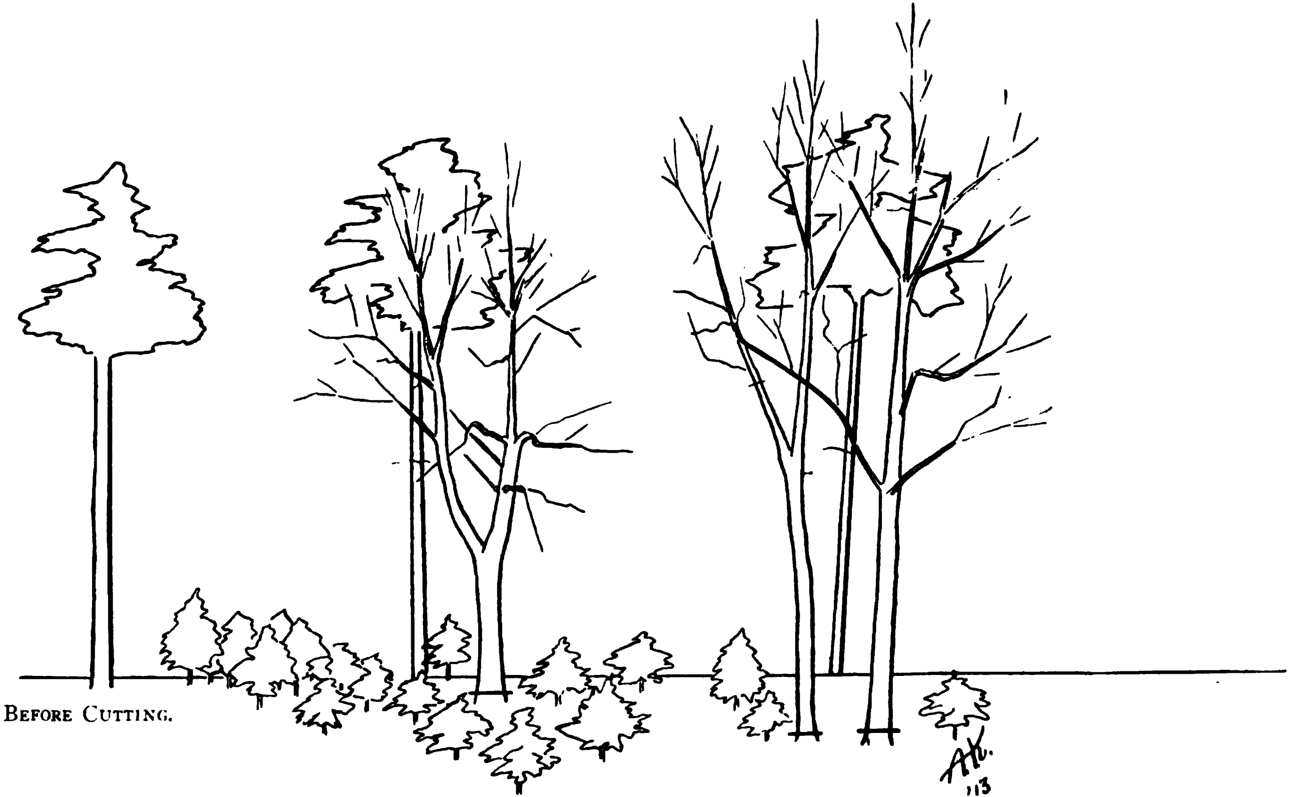
BEFORE CUTTING.

CULLED HARDWOODS.
CONDITIONS FOUND.

Chestnut affected by bark disease; large white oak "wolf tree," etc. Trees indicated should be cut; but the white oak "wolf tree" should not be cut unless the opening be planted-up with desirable seedling stock; otherwise, with such a large opening, weeds and grass would likely take possession of the land. Other trees left will be cut gradually, after reproduction of their kind has come in.



After Cutting.



Before Cutting.

A few old trees had been left, including some white pine. These have seeded abundantly, and will make a good stand. Old spreading hardwoods should be removed now, when possible to do so without injuring young growth. Common in abandoned fields.

PRUNING. Very often woodlots are too open, so that the lower branches of many of the trees are not killed off by shade and do not drop off. This results in an inferior grade of lumber with many knots, etc. With certain species, such as the white pine, even though the lower limbs die because of lack of light, they remain on the tree for years. As to the benefits following pruning there is a difference of opinion among experts.

Pruning is a rather expensive operation, and very seldom pays in direct returns unless the work can be done by steady labor, which otherwise would be unemployed. Returns from pruning lie in the increased value of the final product; and in the aesthetic value of a clean healthy looking woods. Usually only the best trees in form and thrift are chosen to be pruned, as these will be the ones left for the final stand. The trees should not be pruned until the branches are dead for a distance of about twenty feet above the ground. The work should be done in the winter time when growth is stopped. The larger limbs should be sawed off, and all limbs cut off close to the trunk. In pruning, saws, pruning-hooks, axes, and a tool made by fastening a chisel-like head to a long straight rod will be found useful. Care should be taken not to knock off the bark of the trees.

The cost of pruning conifers, from twenty to forty years old is about two cents a tree. Done in connection with improvement cuttings, it has been done for about $2 per acre.

CUTTINGS FOR THE PRODUCTION OF NEW STANDS (REPRODUCTION CUTTING)

When this first improvement work has been done, further cuttings should aim to secure reproduction of the desirable species to harvest the mature crop, and to produce a new and better stand.

When is a Tree Mature? In forestry, maturity of a tree is rather an economic than a purely physical question.

From the standpoint in growth in volume alone, a tree in the forest attains its maximum volume growth a few years after it has made its most rapid height growth. Then it fills out rapidly in diameter. When the rate of diameter growth begins to lessen, the rate of volume growth falls off.

However, because the value of larger sized materials increases rapidly, even after the annual volume growth falls off, the growth in value may increase for some years before it also commences to decrease. The point where increase in value is the greatest represents economic maturity.

Of course, these different points are reached at widely different ages by each kind of tree, and by the same species under different conditions of growth. Similarly, sprouts mature earlier than seedling stock, etc.

Thus, for white pine, economic maturity of a stand is generally about 50 years; for chestnut sprouts about 35 years; for chestnut seedling stock about 75 years; for red oak seedling stock about 80 years; for hemlock it would be over 100 years.

"**Rotation.**" Other factors may modify the choice of the "rotation." By rotation is meant the period of years during which a stand is allowed to grow, before it is cut, and an entirely new stand started. Thus, if cordwood and posts are the products most desired, it might be necessary to use a shorter rotation for those materials, although a longer rotation might be more profitable as far as the woodlot itself was concerned.

Again, where it is desired to secure reproduction from sprouts, it may be necessary to use a shorter rotation, in order to take advantage of the better sprouting capacity of younger trees.

This question will be taken up in detail for different species and types in Volume II.

Systems of Cuttings. Several systems of cuttings are practiced, depending on the condition of the woodlot, on species and ages represented, on species best adapted to the site, on the needs of the owner and on the market conditions. Obviously the systems which would be applicable in a woodlot made up of a fairly good growth of white pine would be different from that which would be practicable in an open, pastured woodlot of old hardwoods. The application of any given system of cuttings will be discussed in detail under the description of woodlot types, and management for the different regions of New York State.

In general the systems of forest management are divided according to the methods of securing the reproduction of a new stand. The two broadest systems of management are those which depend on reproduction from seed, and those which depend on reproduction from sprouts.

In the woodlot the most common practice depends very largely on reproduction from sprouts, although efforts should be made to secure more reproduction from seed.

Reproduction by Sprouts (The Coppice System). Securing reproduction from sprouts is of course applicable only to stands of hardwoods with good sprouting capacity, such as the chestnut, oak, maple, hickory, basswood, ash, etc. In all cuttings where sprouts are desired to form a new stand, there are certain fundamental factors which must be observed.

Factors Governing Sprout Growths. The first is, as noted above, the character of the tree with respect to its ability to produce sprouts. Thus, the chestnut sprouts much better than the white oak.

The second is, that young trees produce better sprouts than old trees. Beyond certain ages trees lose their capacity to sprout. Better sprouts will also come from seedling stock than from old sprout stock.

The third is, that vigorous, healthy stumps produce better sprouts than diseased or defective stumps.

Fourth. Better sprouts come from trees cut during the period when the tree is not growing, that is, in the late fall and winter. Cuttings made while the tree is growing will either result in no sprouts or in weak sprouts, which are likely to be killed by the frosts of the succeeding winter. One way of preventing reproduction from sprouts of undersirable species, or of decreasing the amount of reproduction of certain kinds is to cut all, or part of the trees of that species in the summer time. No sprouts then succeed, or, if they do, they will be less vigorous and thrifty. This is especially desirable in good seed years of the best species in the stand. Conditions are thus made more favorable for seedling reproduction of the best species.

Fifth. Low stumps produce better sprouts than high stumps. Besides cutting low stumps, care should be taken to make the cut smooth and slanting, so that no water can collect anywhere on the inside of the stump, and thus encourage rotting. Care should also be taken in cutting stumps, not to tear the bark on the stumps.

Sixth. Seldom can one stump support over three sprouts to good advantage; and the best growth results when only one or two sprouts are allowed to a stump.

Another thing to be remembered about sprouts is that while they grow faster in youth, they reach their maximum growth at a comparatively early age, generally under fifty years — and often grow too slowly after that to produce profitably large-sized timbers. This is especially true where the sprout growth comes from stumps which have given three or more generations of sprouts.

Three Methods of Securing Reproduction by Sprouts. The simple sprout (Coppice) system consists in cutting clear the old stand and securing an entirely new stand from sprouts. This has been the practice in the hardwood ridges of Southern New York; in both southern and northern New York where stands were cut clean to make charcoal for iron works, or in burning lime; and in woodlots where the whole of the standing timber was sold "by the lot" and cut at once.

The trouble with the application of this system in the past has been that no provisions were made for securing reproduction of those species which do not sprout, nor of favoring better species with poor sprouting capacity against poor species with better sprouting capacity.

Another trouble has been that the stumps have been weakened very greatly by fire and other causes, and that often three or more generations of sprouts have been produced from the same stump, thus further weakening their vitality. Besides this, the species which was best adapted to management under the simple Coppice System, and which was, perhaps, the best species to favor over a large proportion of the woodlots of the State — that is, the chestnut,— is today, throughout a large part of its range, attacked by the very virulent chestnut blight, so that nowhere in the State is it advisable, at present, to favor chestnut further in forest management. So today there are very few stands in New York State where the simple Coppice System would be wholly advisable. Modifications of it, howver, will be advisable in many of the woodlots of the State.

One of the best modifications is based on securing a fairly large proportion of seedling stock to take the place of the weakened sprout stock. This is called the Pole Wood Sprout System.

Two cuttings are made in this system: In the first cutting a heavy thinning is made according to the principles described under Improvement Cuttings, and the first (German) method of thinnings previously described.

As soon as a sufficient amount of seedling reproduction is secured the second cutting is made. This is generally about five or ten years later than the first cutting. The sprouts from this cutting supplement the seedling growth and sprouts from the first cutting, and thus insure a full stand. It is especially desirable, if this method is used at the time the second cutting is made, to slash undersirable species and, wherever possible, release seedling stock which might otherwise be crowded out, according to the methods described in the Improvement Cuttings of Young Stands.

A modification of the Pole Wood Sprout System, useful where it is desired to secure reproduction of certain species, such as oaks, which are not as good sprouters as other species, is as follows: The first cutting takes the trees of the favored species, excepting a few seed trees, which are left along with the species later to be eliminated from the stand. Next, when a good seedling reproduction of the better species has been secured, the seed trees of these varieties are cut. Then, when the seedling and sprout growth of the better species is large enough not to be overtopped by the vigorous sprouts of the less favored species, the trees of these latter species are cut. In this way, a great increase in the amount of the better species is assured.

Another modification of the Sprout System consists in leaving selected individuals to remain over a second rotation. Vigorous, healthy sprouts, which are certain to live for at least the period of the next rotation, and to make good growth, both in volume and value, are selected. If these are sprouts, only one should be left on a stump. These should be well distributed over the whole area, and should be of desirable species. Where seedling stock is on the ground, it is best to leave these for the reserves.

The number of trees left to grow through the second rotation depends largely on the tolerance of shade of the sprouts which are expected. Where these are rather intolerant, as with oak, fewer reserves should be held over than with the more tolerant chestnut, etc. This method also will naturally increase the seedling stock in a stand.

Undesirable Features of Sprout Systems of Reproduction. Excepting the last two Sprout Methods described, it is not recommended for the ordinary woodlot to use Sprout Methods of reproduction, as their present condition and the present market demands make other methods more desirable. Where the need of the owner compels him to cut a very large proportion of his hardwood stand, he should always break away from the simple Sprout Method, and at least leave reserves to grow through a second rotation, and should, if possible, take every step to secure seedling reproduction in his stand.

REPRODUCTION BY SEED.

In the systems depending on reproduction from seed, we have three classes. One, called the Selection System, is applied in stands having a wide range of tree classes of different ages in which the oldest mature trees are taken out and the young, immature ones are left to grow.

Selection System. The Selection System has been practiced unconsciously by most farmers in their woodlots, but they have used it with very little judgment, and often radically wrong principles of selection.

Generally the poorest trees are left, and the best taken, thus leaving the woodlot poorer, not only in its immediate condition, but also as favoring the reproduction of the poorer species and thus increasing their proportion in the succeeding stands.

Again, no consideration is taken of the light requirements of different species, so that often better species, such as oak or hickory, which demand considerable light, cannot compete successfully with tolerant species, such as maple, beech and hemlock.

The Selection System works well where there is use at home or a ready market for cordwood, and a good varied demand for all kinds of special wood products, including sawlogs. The cuttings should be made primarily as improvement cuttings, where conditions require, and secondarily for reproduction. Considerable care must be taken not to injure trees which are left, as in cutting scattered trees in a stand there is great likelihood of injuring the others.

System of Successive Thinnings (*Shelterwood System*). A second system, depending on reproduction from seed, is called the System of Successive Thinnings or Shelterwood System, in which the old stand is gradually removed by a series of thinnings. These thinnings may be distributed uniformally over the whole stand, or may be in groups or strips.

The first cutting is made mainly as an ordinary improvement cutting, and a thinning according to the German method, if more material can be used. In the ordinary woodlot this would take about 25 per cent. of the volume of the stand, and would leave about 150 good-sized trees per acre, where the trees average about twelve inches in diameter. As soon as a fair amount of seedling reproduction is secured, and this has obtained a fair start, a second thinning is made. This would probably be in about five years. If an abundant reproduction has come in all the old stand can now be removed. As noted under the Coppice methods, practically the same system may be used with the aid of sprouts to form a part of the new stand. Should seedling reproduction not be fully established at this time, a light thinning may be made, and in another five years, either all the old stand can be removed, or the thinning process can be repeated, until all the old stand had been cut out within a total period of about twenty years.

As noted, if the regular annual supply of wood material is desired at the same time, it may be secured under this system by making periodic thinnings in groups or strips, taking, say one-fifth of the area each year, and thus making a thinning over the whole area within five years, and repeating the process during the entire period of the first rotation.

REPRODUCTION CUTTING.
Opening up the stand to permit young growth to come in.
(For results, see lower picture on page 10.)

This method is a very good one where it is not necessary to clear all the woods at one time and where a regular amount of produce from the woods is desired. At the same time it provides for a desirable crop of new stock. It is very satisfactory with such heavy-seeded hardwoods as hickory and oak.

Clear Cutting System. The third system of securing reproduction from seed is called the Clear Cutting System. This consists simply in cutting clear, certain definite portions, if not the whole area, and in securing reproduction artificially by planting the area; by leaving a few scattered seed trees on the area; or by arranging the clear cut areas in groups or strips, so that they will seed in naturally from adjoining stands. Where scattered trees are left, care must be taken to select individuals which will not be blown over by the wind. To secure reproduction from natural seeding the minimum number left scattered over the whole area, or the width of strips which may be cut clear, depends very largely upon the character of the seed. Any light, winged seed which can be carried a considerable distance would require less trees to insure good reproduction than would be the case with heavy-seeded trees. Thus, two to five trees per acre of white pine would be sufficient, while ten to twenty of oak would be the minimum. Where cutting is done in strips, these should be on the leeward side of remaining strips, so as to insure better distribution of seed.

This method may be used in a stand where it is desired to convert the great bulk of the wood into merchantable material, yet, at the same time, provide for a second crop of timber. It is best used in such cases, with such trees as the white pine, which produces good seed abundantly and regularly.

It may be that conditions compel, or make advisable the removal of all the old stand, to be followed by planting a new crop. The work of planting is described in the following section.

PLANTING AND SEEDING

Besides the cuttings noted above, and following them, planting or seeding frequently becomes advisable to secure satisfactory conditions in the woodlot. Thus, in any opening where grass is found, and where it would be difficult to secure reproduction of the best species, it would be best to plant such species. Only too often all the trees of the best species have been cut out from a woodlot, so that it would be impossible to secure their natural reproduction. Also it might be desirable to introduce species which had never grown there before. Again, in such spaces where the land is now occupied by large spreading trees of poor quality, it would be better to cut these out and plant.

There are very few woodlots in this State which could not be very greatly improved by planting from one hundred to four hundred trees per acre. Like all other forest planting, the work can generally be done before the ordinary farm work is taken up, so that it will not interfere with that work. In case the market conditions warrant cuttings of the poor material, generally the value received from such cuttings will be enough to pay for the cost of planting the woodlot with new stock, as this is very low.

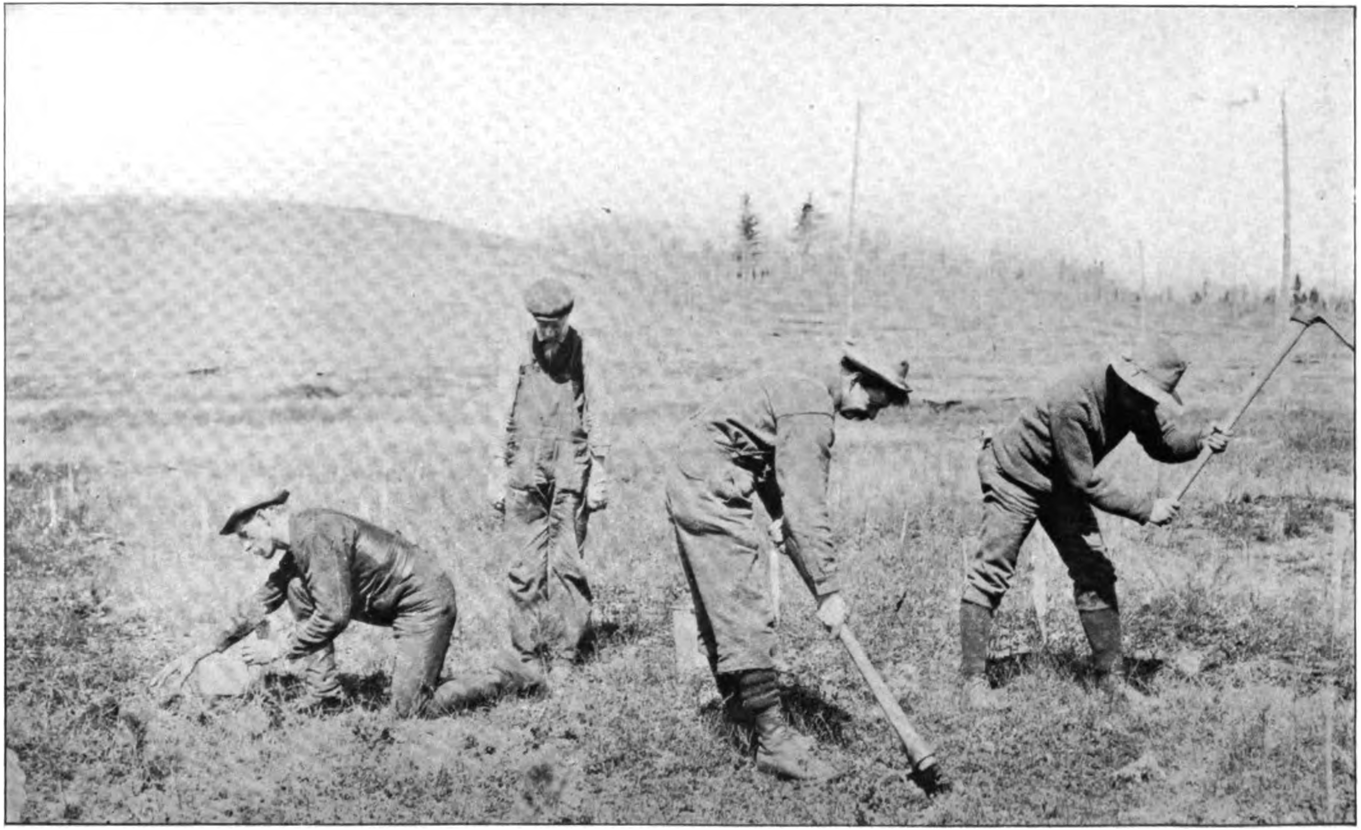


Photo A. Knechtel.

The Four Steps in Planting a Tree.

The cost of planting generally runs from $4 to $6 per thousand, where wages are about $2 per day. Two men, working together, can plant from one thousand to fifteen hundred trees per day. Of course, where planting can be done by permanent labor, otherwise unemployed, the cost of planting is nothing.

Seeding. In a wood lot, direct sowing of seed on the ground often can be very easily done, and practically at no expense, especially if seed trees of desirable species are available. In such cases, seed can be gathered from the trees, and either set out immediately, or, kept over winter and then planted.

In seeding, all leaves, grass, etc., should be removed from the spot where the seed is sown, so that it may come in contact with the mineral soil. As a general thing, the seed should be covered with a light cover of earth, about as deep as the seed is thick. Much better success is generally had from seeding of heavy seeded hardwoods as oaks, hickory, etc., than of other trees. Where squirrels, field mice, etc., are specially numerous, the chances of success from direct seeding are poor.

Where seed must be bought, seeding is generally more expensive than planting, on account of the large per cent. of failure in seeding. But where seed trees are handy, and seeds can be obtained free, often very favorable results follow seeding, and with almost no expense. In large openings, where competition with grass is severe, or where conditions are rather unfavorable, direct seeding is rarely satisfactory.

It might be well here to note that frequently farmers could make money by harvesting the crop of tree seeds, and selling these to large nurserymen or seed dealers. There is now a demand for good seed of nearly all the important kinds of trees.

Underplanting in Existing Woods. This work should be done where necessary to fill up openings in the woodlots, which would take too long to seed up naturally, thus immediately putting all the land to productive use; to introduce new species to make the stand more valuable; or to ensure reproduction of most desired species, difficult to secure otherwise.

In underplanting in the woods, care must be taken not to plant where the light conditions or soil conditions are unsuitable to the species used. Thus, white pine should have a moderate amount of light, Norway spruce could stand a considerable amount of shade, while oak would have to have much light.

Planting Open Lands. SPACING. In planting open, waste land, besides the factors noted previously, there is a question of spacing.

This also must vary greatly, depending on the species, the site, and the local market conditions. Thus, it is quite likely that near cities, where there would be a special demand for such material as Christmas trees, that planting could profitably be done as close as three feet apart each way, provided at least half the trees were of kinds that would be suitable for Christmas trees (Norway spruce or Scotch pine). As a very special case of close spacing, that used in setting basket willows, as close as five inches by fifteen inches might be cited.

Again, near pulp mills, acid mills, or brickyards, where there would be a market for small-sized material, a spacing of not over five by five feet each way could profitably be used, as the trees would not become too crowded before reaching a size where cutting could be profitably carried on. The only general rule that can be laid down is to space at least as close together as will allow the trees to reach a size where they can be profitably cut before excessive crowding takes place. With most species this will not exceed a spacing of six by six feet each way in New York State. Besides, a spacing greater than this will give too long a period before the ground is completely shaded, so as to give the best conditions for growth, and the stand would be so open that the trees would be limby, or forked.

Special cases might arise warranting greater spacing where the principal aim would be for some particular product. Such, for instance, might be the case in a walnut grove, but this really would not be typical of forest management.

KINDS TO USE. The New York State Conservation Commission has issued a bulletin (No. 2) on "Reforesting" which fully describes the methods, the conditions and the kinds of trees best suited for reforesting in this State. This is supplied, free of charge, upon request, and should be carefully read by all those who desire to plant. There should also be carefully noted the characteristics of trees with regard to the factors of growth, discussed under "Principles of Forest Growth."

STOCK TO USE. The Commission also grows in its own nurseries tree stock of the best species, which it sells to residents of the State, at cost, and, as a general proposition, people desiring to plant can secure the best stock at the least cost from the Commission. It is possible, however, where labor is at hand which could not otherwise profitably be used, to dig up wild stock, from natural seeding, of desirable species, and transplant these on the planting site.

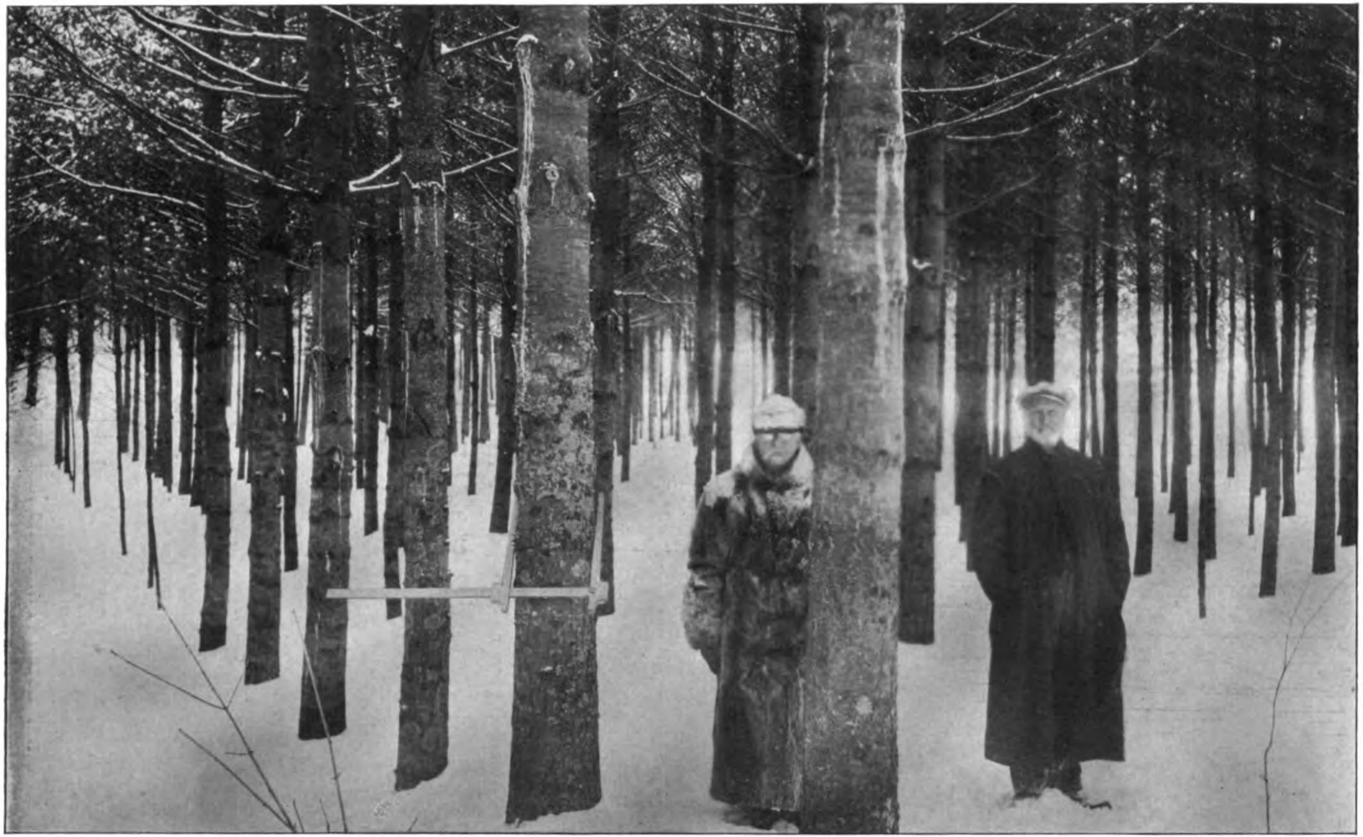


Photo by C. R. Pettis

Plantation Results.
Twenty-eight years old; 24,000 board feet lumber per acre.

This wild stock, however, is seldom very satisfactory, because not grown under the best conditions to withstand transplanting. Further, if the labor of digging it up must be paid for, it will generally be more costly than the State's nursery stock.

Exemption from, or Reduction of Taxes on, Reforested and Well-managed Woodlands. To encourage reforesting of waste land or the improvement of poor woodlots by underplanting with desirable species, several laws have been enacted exempting such lands from taxation or reducing assessments thereon.

Two laws relate to land when planted with forest trees.

One (section 89 of chapter 444, Laws of 1912) relates to lands, in areas of at least five acres, where the assessment on such land, or on other waste, denuded or wild forest lands in the tax district, has not exceeded five dollars per acre for the preceding five years. This land, when planted in a manner approved by the forest commission, shall be listed at the assessment as shown for the previous five years; and no increase in assessments shall be allowed for thirty-five years, nor shall the trees or timber thereon be taxed.

The other (chapter 249) provides that areas of not less than one acre or over one hundred acres, if planted with not less than eight hundred trees per acre, shall be exempt from assessment and taxation for any purpose for thirty-five years; while if existing forest or brush land be planted with not less than three hundred trees per acre, such land shall be assessed for thirty-five years at half the assessible value of the land, exclusive of any growth thereon. At the end of that period, a charge of 5 per cent. is collected on the assessed stumpage value of timber, whenever cut.

A third law (chapter 363) refers to woodlots, not exceeding fifty acres in extent, which shall be managed according to approved forestry methods. It provides that such land shall be assessed at not more than ten dollars per acre, and in fixing the value of the land, no account shall be taken of the value of growing trees. Excepting cutting for firewood or building materials for domestic use, other trees, when cut, shall be designated by the Conservation Commission and a tax of 5 per cent. levied on the assessed stumpage valuation of the timber so cut.

Wise provisions were made to ensure that the lands so taxed should be best suited for forest purposes, although otherwise unproductive, and to exclude from the enjoyment of the benefits of this exemption and reduction, lands which would derive their chief value in other uses. Thus, the last two acts exclude lands within twenty miles of cities of the first class; within ten miles of cities of the second class; five miles of cities of the third class; and within one mile of incorporated villages.

Detailed information concerning these laws, and how to take advantage of them, can be had from the Conservation Commission. Bulletin No. 8 gives a full discussion.

REGULATING THE CUT

Owing to the small size of the ordinary woodlot, and its run-down condition, it will seldom be practicable for some years ahead to plan for a definite amount of cutting per year. The emphasis must be put on work for the improvement of the stand both by bettering conditions for the remaining trees; and in securing and increasing the proportion of reproduction of the most desirable trees. However, it may often be advisable to limit the cut, so that the woodlot may at any time be called on to supply a given amount of material. Thus, a farmer may need every year twenty-five cords of wood, 100 fence posts and, every five years, 2,000 board feet of lumber or 400 board feet a year.

The first thing in regulating the cut is to know the amount standing of all kinds and sizes, and the next thing is to determine the growth of the stand. Methods of estimating the stand are described later.

Growth and Yield. Methods of determining growth are mostly too complicated for the average woodlot owner to bother with. It is, therefore, not intended here to go far into the methods of studying the subject. A very rough method, which may be useful, is as follows:

Select at least two trees in each diameter class (diameters taken breast-high) of each kind of tree. Trees should be selected so as to be of about average form for that diameter class.

Cut out a piece, so that the bottom will be four and one-half feet from the ground, and will have at least one inch of wood, besides the bark. The bottom should have a straight, clean surface.

Measure off one-half inch from just within the bark in the direction of the heart on the lower surface of this piece. Then count the number of rings in this outer half-inch of wood. (These rings may be noted, sometimes very clearly, as in the oak, sometimes very faintly, as in birch, on a clean cut surface at right angles to the height of the tree and each ring represents one year's growth.)

The number of rings in this outer half-inch may then be assumed to be the number of years taken by a tree from the next lower inch class to reach the diameter class of the tree measured.

Thus, we will assume that on the present seven-inch trees, in the outer half-inch of wood we found an average of five rings. Then, we would say that it will take a six-inch tree five years to become a seven-inch tree.

As we generally want to know the amount produced each year, we will now look up in the volume table for that species, the volume of both seven and six-inch trees, subtracting the volume of the six-inch tree from that of the seven-inch tree, and, in this case, dividing by five (the number of years for a six-inch tree to reach seven inches) and we have the amount of the volume growth per year of the six-inch tree. This amount, multiplied by the number of six-inch trees found in the stand, gives the amount produced by the six-inch trees.

Similarly, the amount grown by each inch class is found.

Then the amounts grown by all the trees in each inch class are added up and the total obtained.

This is the annual growth in volume of the stand.

It is the intention, in Part II of this bulletin to give the results of studies on growth and yield of the principal forest trees and types.

GROWTH OF DIFFERENT SPECIES. To give an idea of growth and yield, the following figures may be useful. These, of course, cannot be used as more than an illustration of growth; the figures are for the average active growing period of the trees.

Under ordinary woodlot conditions, with the stand not under management, and generally with some of the trees weakened by old fires, etc.:

White pine, red pine, chestnut (seedlings), oak (seedlings), etc., take 5–7 years on an average to grow one inch.

Chestnut, oak and similar sprouts take 3–5 years to grow one inch.

Beech, birch, maple, spruce, etc., take 10 years or over to grow an inch.

GROWTH OF DIFFERENT STANDS. In *well-stocked*, but *unmanaged*, hardwood stands, the annual yield has been found to vary from a maximum of about 1.2 cords per acre on first quality chestnut, in sprout stands up to 35 years old; to as low as .6 cord in third quality oak sprout stand on a 40-year rotation.

A fair average for such well-stocked stands, and the rotation on which ordinarly the various products named are the most profitable form into which a stand of that age can be worked, is:

ROTATION	PRODUCT	GROWTH PER ACRE PER YEAR
30–35 years	Cordwood	.8 to .9 cord
35–45 years	Ties	2.5 to 3 ties and ¼ cord of wood additional
50 years and over	Poles (where species in the stand permit)	.6 to .7 pole and about ⅓ cord of wood additional
55 years and over	Lumber	200 to 250 board feet of lumber and ⅓ cord of wood

Extra good natural stands of white pine have yielded from 1.1 to 1.7 cords per acre per year.

Under management, not only can this be increased greatly as to final yield, but intermediate yields, from improvement cuttings, often will add considerably to the profit. Especially is this true in the ordinary hardwood stand.

Having determined the yield per acre, the yield of the whole stand will equal the yield per acre multiplied by the number of acres in the stand.

How Much Can Be Cut. The average amount of wood grown each year on the whole tract, or somewhat less, will be the amount which can safely be cut from the woodlot annually. It may be cut anywhere on the tract.

Generally, the amount cut should not exceed a rate of three-fourths to one cord per acre for the present, if a sustained yield is to be maintained. After several years of management, this rate may be increased.

When the woodlot is not large enough to produce the needed amount at present, it will often pay to buy wood from neighboring woodlots. The prices of wood products are constantly increasing and by buying now, a home supply later may be assured.

Of course, the *determining factor* here also must be the *condition of the stand.* Thus, where a large number of overmature, unhealthy trees are found, it will be best to aim for a new crop of good trees as soon as possible, rather than to aim to regulate the cut to any given amount.

IV. BUSINESS MANAGEMENT FOR THE WOODLOT

SELLING THE PRODUCT

The ordinary woodlot owner has only a very indefinite idea of what his woodlot is worth, or how best to market the product. In cases where he sells the cordwood only, he may know about what it is worth as cordwood, but rarely does he figure whether he could not greatly increase his revenue by selling each tree to the best advantage. Thus, strange as it may seem, in the year 1912, some farmers are still cutting black cherry for railroad ties — and this in a district near large furniture factories.

Loss in Selling by Ordinary Methods. In selling a lot of mature timber, the general practice is to sell "by the lot," receiving a stipulated sum for all the wood on the tract. This arrangement is one which practically always works out to the benefit of the buyer rather than to the owner of the woodlot, as buyers generally figure on at least a 25 per cent. margin.

Not only is this true of the value of the material cut, but the owner's greatest loss lies rather in the fact that no provision can be made to save any desirable trees for a second crop. The buyer paying a fixed sum for everything in the lot, will "skin" every stick that will yield any profit, and will take no care of young growth which he cannot use, so that what is left to the owner of the woodlot is, indeed, a very poor tract of woods.

Many buyers of such timber lots would prefer to buy and pay for only the mature, or at least the larger trees, leaving material for a second cut within a few years; but when they buy by the lot, they naturally continue the old skinning method.

Better Methods of Selling. It is thus seen that the owners of woodlots should at least abandon the outright sale of all the wood "by the lot," and sell by the unit — so much per thousand feet of lumber; so much per pole, etc.; based on the quantity actually cut, or estimated to be standing on the tract, and should stipulate that great care be used to prevent undue injury to young growth (with a fine attached for trees carelessly broken), and that trees below certain diameters be left, as well as a few selected individuals of trees above those diameters, which may be marked.

Best results will be obtained by having the work done directly by the owner. Where this is impossible, it should be done under his supervision, or with frequent inspection by a trustworthy representative.

Contract work in the woods should be guarded by carefully drawn provisions regarding all the important features of the work. These should be put in the form of a written contract, signed by both parties.

Best Sale Contracts. In a complete detailed contract, the following provisions would be included:

(1.) Timber to be cut.
  Quantity and location of cutting.
  Sizes of trees to be cut or saved.
  Kinds of trees to be cut or saved.
  Provisions for exceptions to the above clauses by marking of special trees to be cut or saved. If possible, best to allow only those trees to be cut which are marked for cutting.
(2.) Provisions against waste.
  Low stumps — generally height of stump not to exceed diameter.
  Tops to be utilized as fully as possible — should specify diameter to which material must be taken.
  Everything merchantable to be taken. Specific amount of defects to which products are considered merchantable.
  Most profitable form of product to be made; specifying products to be made, if possible, from trees, or portions of trees (thus, that certain sizes be converted to logs, others to poles, etc.).
  Only dead trees, or certain inferior kinds, to be used for roads, skidways and other lumbering operations.
(3.) Protection against damage.
  Care against injuring trees to be left.
  Disposal of tops.
    Always require that these are lopped so branches are close to ground; or else piled, and, if advisable, burned.
  Other work necessary to ensure protection from fire, and responsibility for fires occurring while on the work.
  Any fences removed, etc., to be replaced by substantial new fences.
(4.) Locations of camps and mill-site, etc.
  If these are used, provisions concerning them should be made.

(5.) Measurements.
  - Where made — generally should stipulate that contractor make suitable piles and yards of different materials, where same should be measured.
  - How measured:
    - By different products, and specifications for each.
  - Log Rule used in measuring logs should be stipulated.
    - The best rule to use is the International Rule given in the back of the book.
    - Methods for allowing for defects and grading should be stated. Where sawing of lumber is done on that tract, or nearby, it is best to measure actual board feet contents of boards; also providing for slabs and other mill waste.

(6.) Payments.
  - Time — generally at least half should be paid as soon as trees are cut; and the rest before removal from land.
  - Price per unit of measurement for each grade of material specified.

(7.) Faithful performance.
  - Bond or other guarantee of at least one-quarter of the value of products included, should be required.
  - Penalties for violations of different clause should be stipulated;— generally in case of cutting trees to be left, or failing to remove trees marked for cutting, at double the ordinary price agreed on; while for carelessly injuring trees to be left, or other violations, a definite sum for each offense.

(8.) Disputes.
  - Either should stipulate that judgment of the owner be final in any dispute as to material cut, etc.; or that it should be left to a professional forester, whose expenses should be borne equally by each party.

(9.) Duration of contract.
  - Should stipulate when work is to begin and end, and certain amount to be done within given limits of time. Repeated violations of any terms of the contract shall terminate same, with forfeiture of bond for faithful performance.

ESTIMATING THE STAND OF TIMBER — THE INVENTORY

Value of the Inventory. In cases where the product sold is based on the actual amount cut, it is not necessary to know the amount standing before the cutting is done, in order to make a fair contract for payment. However, in management it is very desirable to know just how much of each kind and size of trees is standing in the woods, in order to base calculations as to the amount which may be cut at any time, and still leave a definite amount for future cuts; to place intelligently a value upon the woodlot; and to know how and where best to market the product and to make contracts for cutting.

Various methods of estimating the stand of timber are in vogue. It must be remembered that to make an accurate estimate requires skill and experience, and if the woodlot is of valuable material and good size, it will pay best to hire a forester to make the estimate. He can, at the same time, make a plan for the best method of management. This will save money on such lands.

Methods in Small Lots. In the woodlot the area is generally so small that the owner could go through it and count all the trees, and determine just what an average-sized tree would be; find the contents of that average-sized tree; and multiply that by the total number of trees. Or, he could estimate the contents of each tree separately. Unless the woodlot is very small, it would be more practicable to determine the number of trees of each inch class of diameters; find the volume of the average tree of each diameter class, multiply the volume of the average tree of each diameter class by the number of trees in that class, and add together the volumes obtained for each class and thus secure the total volume on the whole area.

In estimating by diameter classes, it is generally the custom to take the diameter of trees at breast height, or four and one-half feet from the ground, in order to be above the root swellings, which vary with individual trees. In measuring diameters an average diameter is taken. Where all the trees are counted, it is best to mark them in some way as they are counted, in order to avoid counting any of them more than once. Plain chalk can be used.

A very useful instrument for measuring the diameters is a pair of calipers, constructed so that one beam is fixed at right angles to the end of a graduated stick, while the other slides along the stick. When the movable beam is pressed against the tree, it stands at right angles to the scale; and the diameter in inches, read off on the scale, gives the diameter of the tree.

Volume Tables. Based on such measurements at breast height, a large number of tables showing the volume of trees of different diameters has been constructed. Where such a table can be found, all that is necessary to complete the estimate, after determining the number of trees of each given diameter class, is to look up in the table for a given species the volumes of trees of the same diameter and average height, and to use the volume there given. Where no volume table exists, it will be necessary to determine the actual contents of at least a few trees in each diameter class. This may be done by selecting trees of as nearly average form as can be found; cutting them down and then working them in such a way as would be done for the market. Then each log, if logs are cut, can be scaled separately, with the ordinary log rule used for scaling logs in that district, and the total board foot contents thus determined. Cordwood, ties or poles may be estimated either by working the tree into those products and determining the actual amount thus obtained; or by determining the solid cubic foot contents, and allowing such converting factors, as for example, ninety cubic feet to one cord of wood. Where the cubic contents are measured, the diameter of each piece is measured at both ends, and the average diameter is taken; the area of a circle of that diameter is found, and that area mutiplied by the length of the piece. The volume of the piece is the result. The sum of the volumes of each piece gives the volume of the tree.

However, in actual practice, it will seldom be practicable or necessary to make such a volume table. It will be easier either to use the volume tables already constructed, or to determine the contents of average trees by actually working them into the finished products, and by measuring the amounts of those products.

The best volume tables give volumes for trees not only of certain diameter classes, but also for different heights of each diameter class, because the volume of trees varies, not only with the difference in diameter, but also largely with the difference in height. That is, a tree of four inches in diameter at breast height, that is twenty feet high, will have a very much lower volume than a tree four inches in diameter and fifty feet high.

It is then necessary in estimating, either to record each tree separately as to diameter and height, or to find the average height of trees in each diameter class. A simple way of determining height is to place a ten-foot pole alongside of the tree, and, stepping off to a convenient distance from the tree, figure the height by eye, comparing the height of the tree with the ten-foot pole.

Volume tables for some of our common trees are found in the appendix of this bulletin. In estimating, some convenient form of recording the results must be used. The most convenient form is that shown on the opposite page.

FOREST TYPE: Mixed soft and hardwoods

Area of Plot, ¼ acre. Method of Estimating Used, Sample Plot

Relative Condition of all areas of this type in the surrounding district to Plot Estimated ....

DIAMETER BREAST HIGH	Pine	Spruce	Beech	Birch	Maple					Miscel-laneous	Total	Total number per acre	Per cent per acre	MERCHANTABLE CONTENTS PER ACRE			
														Cords	Ties	Poles	Lumber
Under 2 inches																	
2–4 inches																	
4–6 inches																	
7 inches																	
8 inches																	
9 inches																	
10 inches																	
11 inches																	
12 inches																	
13 inches																	
14 inches																	
15 inches																	
Number														VALUE PER			
Number per acre														Cord	Tie	Pole	Lumber per M
Per cent total																	
Per cent total over 2 inches														TOTAL VALUES PER ACRE EACH KIND			
														TOTAL STUMPAGE VALUE PER ACRE=$			

NOTE.— Enter in upper right hand corner of Squares, average height of trees of each class and species.
Enter in lower right hand corner of Squares, number of years, for trees of each class and species to grow last inch.
Estimate contents of all trees in most valuable products, plus amount of less valuable material to 2 inch top diameter.

REMARKS:..
....
....
....

AVERAGE TREE (Leading Species)

Diameter.................... Height.................... Age....................
Signed..
Date..

Methods in Large Woodlands. Where the area is too large to measure all the trees, or where time does not permit it, various short cuts to an estimate may be used.

Sample Plots. One convenient way when the area of the woodlot is known, is to measure off some definite portion, such as one acre or five acres, determine the amount standing on this small area according to the methods described before, and multiply the amount on this area by the figure which shows the proportion between the small area, and the whole. That is, if the small area is five acres, and the whole one hundred acres, multiply the volume on the small area by twenty.

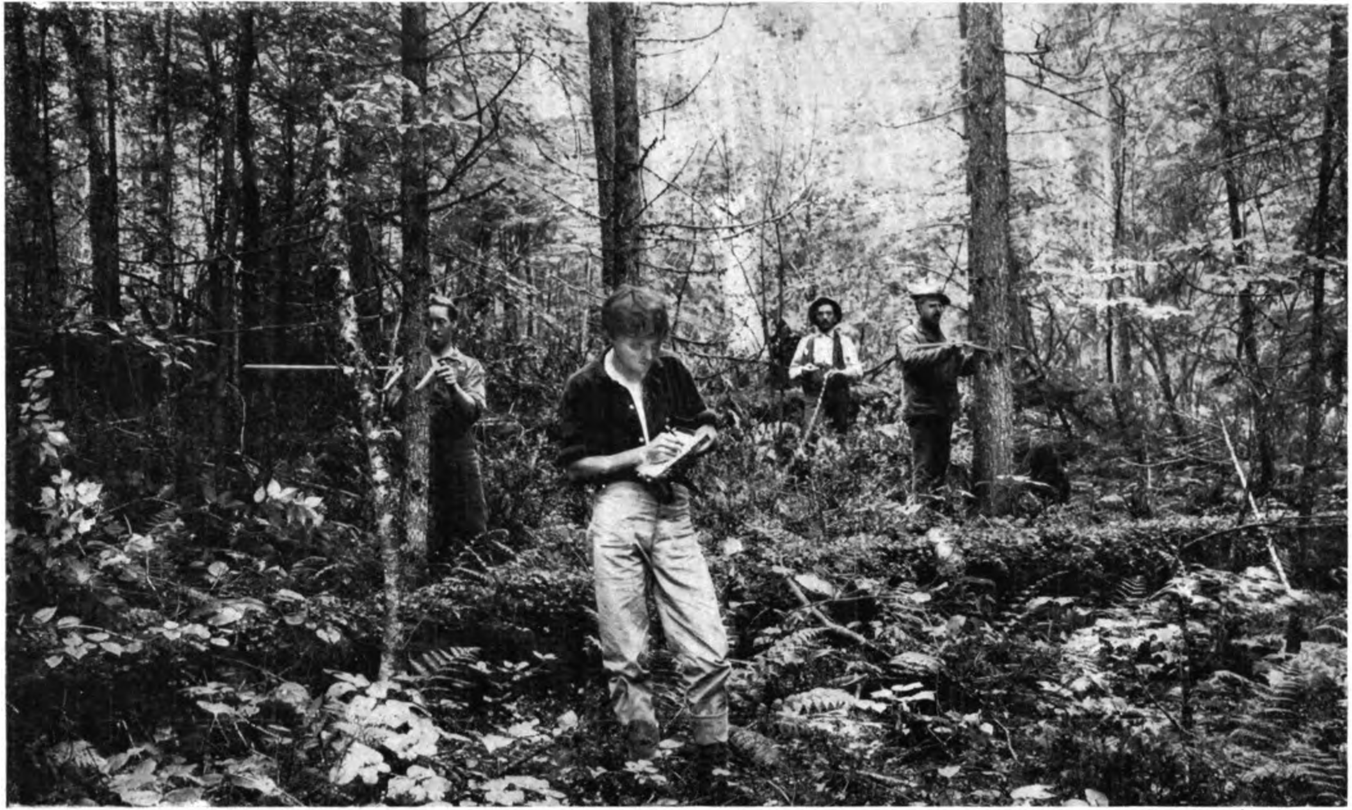
Good judgment must be used in order to select these sample plots that they shall be representative of the whole area. It may be convenient to know that a plot of 208 feet square makes an acre; or that a circular plot with a radius of 85 feet is a half acre.

Strip Methods. In still larger areas, where it is difficult to select sample plots which would be fairly representative of the whole stand, it is often convenient to run strips at fixed intervals through the stand. All the timber on these strips is estimated and multiplied by the number of times the strips are contained in the total area. Strips should always be run at right angles to the main slopes; that is, up and down hills, rather than along them. Where very noted changes in the type of forest occur, the amounts in each type on the strips should be estimated separately, and the estimate applied to the area of each type.

It will be seen from this that in using these methods it is necessary to know at least the total area of woodland, and it is much better also to now the area of each type. This involves the mapping of the area.

It is not possible to describe here the way to make such forest maps. Unless the area is very large, or a very accurate map is wanted, a fairly good map may be made by the use of an ordinary hand compass, and by pacing, or else by chaining distances.

In estimating strips, it is most convenient either to take 16½ feet on each side of the line run, or 33 feet on each side. Then, for every chain (66 feet) forward along the strip, in case where 16½ feet on each side of the line has been taken, one-twentieth of an acre has been estimated; where 33 feet on each side of the line, one-tenth of an acre; for every tally of 10 chains (66 feet) in the wider strip, an acre has been estimated; in the smaller, one-half acre.



Courtesy Prof. A. S. Bickmore

Measuring Standing Timber — Strip Method.

It is best to tally each acre separately; and where the line ends before a whole acre has been estimated, the number of chains should be noted, and that fraction of an acre used for the strip estimated, rather than continuing on the same sheet back on another line.

Strips sixty-six feet wide, run one-quarter mile apart, will give an estimate of 5 per cent. of the whole area; one-eighth mile apart, 10 per cent. of the whole area, etc.

In sample plots or strip methods of estimating at least 5 per cent. of the total area must be estimated in order to have accuracy in the result; but it will be better to estimate the stand on a greater percentage of the area. Generally an estimate of 20 per cent. of the whole area would give a very accurate estimate for the whole stand.

THE MARKETS.

Value of Knowledge of Best Market for Each Product. In order to know what a tract of timber is worth, it is necessary to know the value of the products. Not only should the general uses of the different kinds of wood be known, but careful attention should be given to any special use for given kinds or sizes of trees, which may result in increased value.

The market for native woodlot timber in this State is chiefly for ties, poles, firewood, posts, piles, rails, lumber, and very frequently in the round for pulpwood, acid factories, and box manufacturers; while special kinds, such as fine white oak, ash, second-growth hickory, cherry, etc., have a large number of special uses, such as, in the vehicle industry, furniture making, etc.

It is again urged that owners should be particular to inquire into their special markets, both for the different kinds of timber, and for the most profitable form into which given sized trees may be worked. By taking advantage of this, they can very frequently double the price received for their products.

Principal Products and Prices. The following information concerning the principal products of the woodlots of this State may be of interest.

Lumber. Lumber is sawed from almost every kind of wood. The principal uses of each kind are given later, together with the average price of each kind. Prices given show the average price at the mill per thousand board feet of lumber "log run," *i. e.*, the average of all the products sawed from the logs. The average value of the "log run" of lumber cut in New York State woodlots is about $25 a thousand feet board measure.

Poles. Poles are mostly of chestnut. The following specifications and prices are of interest:

All poles shall be of sound, live, white chestnut, squared at both ends, reasonably straight, well proportioned, from butt to top, peeled and knots trimmed to the surface of the pole.

The dimensions of the poles shall be according to the following table:

The "top" measurement being the circumference at the top of the pole.

The "butt" circumference being six (6) feet from the butt.

Prices of Poles of Different Specifications

Class "A"

Length of pole	Top	6 feet from butt	Price
25 ft.	24 in.	36 in.	$2 75
30 "	24 "	40 "	4 00
35 "	24 "	43 "	5 00
40 "	24 "	45 "	6 00
45 "	24 "	48 "	7 00
50 "	24 "	51 "	9 00
55 "	22 "	54 "	11 00
60 "	22 "	57 "	13 00
65 "	22 "	60 "	15 00
70 "	22 "	63 "	18 00
75 "	22 "	66 "	25 00

Class "B"

Length of pole	Top	6 feet from butt	Price
25 ft.	22 in.	33 in.	$2 00
30 "	22 "	36 "	3 00
35 "	22 "	40 "	4 00
40 "	22 "	43 "	5 00
45 "	22 "	47 "	6 00
50 "	22 "	50 "	7 50
55 "	22 "	53 "	9 00
60 "	22 "	56 "	12 00
65 "	22 "	59 "	14 00
70 "	22 "	62 "	17 50
75 "	22 "	65 "	22 50

Class "C"

Length of pole	Top	6 feet from butt	Price
25 ft.	20 in.	30 in.	$1 50
30 "	20 "	33 "	2 50
35 "	20 "	36 "	3 25
40 "	20 "	40 "	4 25
45 "	20 "	43 "	5 25
50 "	20 "	46 "	6 25
55 "	20 "	49 "	7 00
60 "	20 "	....	9 00
65 "	....	....	11 00

Class "D"

Length of pole	Top	6 feet from butt	Price
25 ft.	20 in.	27 in.	$1 00
30 "	20 "	31 "	1 75
35 "	20 "	35 "	2 25
40 "	20 "	39 "	3 25
45 "	20 "	43 "	4 25
50 "	20 "	46 "	5 50

Ties. Ties are usually 8 or 8½ feet long.

First class ties are 7 inches thick and not less than 7 inches or over 12 inches wide at any place on the face, and must be hewed, or sawed, on two faces; sometimes allowed to be sawed on four sides, and then to be 7 inches by 9 inches.

Second class ties are 6 to 9 inches thick, and with a face not less than 6 inches wide.

It is generally stipulated that not over 25 per cent. of second class ties will be accepted on any contract.

By far the most common woods used for ties are chestnut and the various oaks. Red oak is discriminated against, either fetching a lower stated price, or ties of first-class dimensions being considered as second-class white oak. The following prices may be taken as a fair average:

	Cents.
First Class Ties:—	
Chestnut	53
White and other oaks	65
Red oak	45
Second Class Ties:—	
Chestnut	47
White and other oaks	53
Red oak	41

CORDWOOD. Cordwood is generally sold by the cord in ranks eight feet long, of wood cut into sticks four feet long, and stacked to a height of four feet. Near towns, however, it is very frequently cut into shorter lengths, such as twelve or eighteen inches, so as to be of stove size; but this generally fetches almost the same price as four-foot pieces, on account of the extra convenience to the user.

Cordwood for firewood is worth about $4 per cord for chestnut and similar woods; $5 for oak; and $6 for hickory.

Poplar and spruce cordwood for pulp or excelsior, is worth about $8.50 at the mill.

CHARCOAL. Charcoal is worth from six to ten cents a bushel.

Uses of Principal Kinds of Woods, and Prices. The most important general and special uses of our most important woods and average value "log run" for each kind, under average woodlot conditions, is given below and should prove very useful. Average "log run" values are considerably below the value where used for some special purpose. The owner therefore should always look for the very best market for his product; and for that product most in demand and yielding the greatest profit.

ASH. White ash is used mostly for agricultural implements, vehicle stock, furniture, basket veneer, and many special uses. Good white ash is especially valuable, and should always secure a special market.

Black ash is rather less valuable than the white ash and is used mostly in veneer stock, for baskets, etc. The average price is about $21.50 per thousand feet of lumber, although it frequently reaches $40 per thousand or more.

ASPEN. Aspen is generally sold by the cord. The average price is about $8.50 per cord at the mill. Its common uses are for excelsior, pulp, boxes, crates, veneer baskets, etc. Popple brings about the same price, and used for the same purposes.

BASSWOOD. Basswood is generally sold for lumber of the better grades, and special stock is used mostly for vehicles, in furniture, for veneer stock, etc. Its average price is about $21.00 per thousand feet.

BEECH. Beech is sold mostly for lumber and cordwood. Its average price is about $14.50 per thousand. Its main use is for agricultural implements, furniture, and novelties, such as clothes pins, wooden blocks, musical instruments, etc.

BIRCH. Birch is sold for lumber or cordwood at an average price of about $20 per thousand feet. Its main uses are for furniture, and veneer stock, and for interior finish. This wood is often stained and used as a substitute for mahogany. Good birch logs should always command a special price.

White birch and paper birch very seldom grow to sizes large enough to warrant use for lumber, and are mostly used for cordwood; and for wooden novelties, such as clothes pins, toothpicks, spools, etc.

CEDAR. This is used mostly in the round for posts and poles. The red cedar very seldom grows larger than post size. The white cedar makes poles as well as posts, and shingles and lumber are made from it. Its average price is $24 per thousand feet.

CHERRY. This is mostly used for fancy furniture. Any tree which will yield a good log should be worked into furniture stock, and should always command a special price for this purpose. Its average price is $30 per thousand feet.

CHESTNUT. Chestnut is used mostly for cordwood, ties, telephone poles and piles, and also very largely for bridge and car construction and furniture, and a large variety of miscellaneous purposes. The average price is about $19 per thousand feet.

ELM. Elm is also a wood with a large number of special uses for which it has a special value.

The white elm is the best of the elms. It is used mostly for cooperage stock, vehicle stock, and in such implements as wheelbarrows, etc., where especially strong wood is desired. Its average log run price is now $23 per thousand feet.

HEMLOCK. This is sold mostly for ordinary lumber and pulp. It is rather an inferior wood. The average price is $15.75 per thousand feet.

HICKORY. This is used mostly for agricultural implements, tools, vehicle stock, etc. Good hickory is growing scarcer and scarcer and should always command a special price. Frequently trees are worked up into ties, posts and cordwood which should be left to grow lumber. The average price is $25 per thousand; although hickory finds a ready market up to $60 per thousand feet. Hickory cordwood brings about $6 per cord.

LOCUST. This is used mostly for posts, ties, insulator pins, etc. The average price is $20 per thousand feet.

MAPLE. Maple is used mostly for furniture and fancy interior finish, wooden novelties, musical instruments, and a very large number of special uses. Its average price is $18.75 per thousand feet.

Red maple is very inferior to the sugar maple and can only be used in a very limited number of ways as compared to the sugar maple. Special grade maple can always command a special price, especially if it has a twisted grain, making the famous bird's eye maple.

OAK. Oak is used mostly for agricultural implements, vehicle stock, car construction, furniture and interior finish. Its average price is $25 per thousand feet, although good oak can generally find a ready market up to $45 per thousand feet.

The white oak is more valuable than the red oak, but both command the best price when cut into good logs for sawing "quarter sawn" lumber for furniture. Oak is also used to a large extent for ties, posts, etc. Very often trees are worked up into ties and posts which should be left to grow for lumber. Tops and smaller sizes can be cut into cordwood and brings a better price than ordinary cordwood.

PINE. The white pine is used for almost every purpose. The smaller sizes and inferior grades find their best uses for boxes, while the better grades and larger sizes are most valuable for furniture, interior finish, and for special uses, such as molds, match stock, etc. The average price is $23.75 per thousand feet.

The red pine is used for much the same purposes as the white pine.

The pitch pine or yellow pine is used mostly for lumber, and is inferior even for that purpose. Near metallurgical works, such as smelters, a special use for this is found in the form of poles used in the reduction process. Pitch pine is often marketed in the smaller sizes for cordwood.

SPRUCE. Spruce is used mostly for pulpwood, and larger sizes for ordinary building lumber, and, to a certain extent, for boxes. The average price is about $19 per thousand feet.

Tulip Poplar or Yellow Poplar. This is used mostly for interior finish, cigar boxes, and furniture. It is a high grade wood and generally can command a special price. The average price is about $40 per thousand feet.

LUMBERING COSTS

The owner, having estimated the amount of wood which he has standing and knowing the value of it in the markets which he can reach conveniently, now wishes to know what it will cost to get his material from the tree to the market. When he knows that he is in a position to place a value on the standing timber.

In this discussion, we are taking account only of standing timber of merchantable size, which, it must not be forgotten, is much below the real value of the whole woodlot.

The costs of marketing the timber are:

First. Cutting down the trees and working them into logs, poles, ties, cordwood, etc.

Second. Skidding into convenient piles, or to a sawmill, if there be one on the tract.

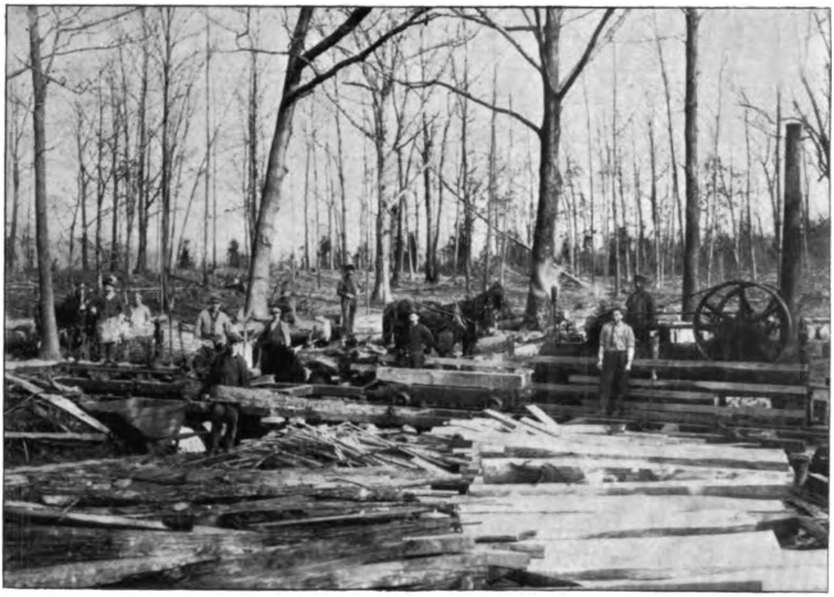
Third. Hauling logs to a sawmill, if it is not on the tract; or hauling lumber and other products, such as ties, etc., to market, loading on cars, if necessary.

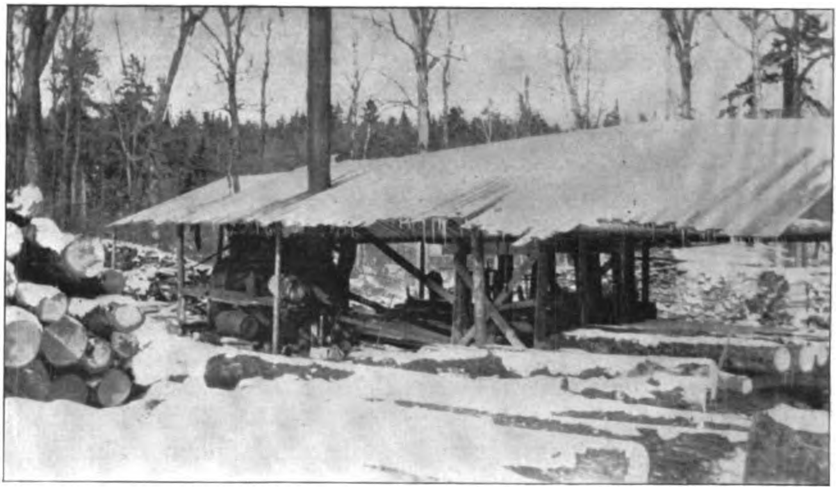
Fourth. Cost of sawing, piling, etc. While the costs of these various factors differ greatly according to circumstances, the following figures are given as fair average costs under woodlot conditions in the State, and will serve as a guide in valuing timber.

Cost of Hauling. Naturally the most variable cost is that of hauling on account of the different distances to be hauled; because of difference in the nature of the country and condition of the roads; and through difference in weight between seasoned and greenwood, etc.

A large share of the lumber from woodlots is cut by small portable mills. These can be moved for from $50 to $100, and a stand of 75,000 to 100,000 board feet will warrant a "set up." Therefore, where the haul to any established mill is too long to be profitable, it may pay to have a portable mill come in and saw the logs. Often where there is not enough in one woodlot, two or three owners might combine to have a portable mill set up.

In hauling, an average load for a team along ordinary country





TYPES OF PORTABLE SAW MILLS.

roads is about 1,000 board feet of lumber; 32 first-class ties, 38 second-class ties, six 25-30 foot poles, four 30-35 foot poles, two 35-45 foot poles, or one cord of wood.

Ordinarily a team will average for a day's work, loading, hauling the load 6 to 9 miles, and then returning. The best time to haul is in winter, when sleighing is good.

The cost of a team and driver varies from $4. to $5.50 a day. Generally a team can be hired cheaper in winter than in summer, as in the former season farmers want work for their horses.

In the following figures, it will be assumed that the average cost of hauling is $5 per thousand board feet — that is, that the average load above given, will be hauled; that only one trip per day can be made, and that the wages for the team and driver are $5 per day. This is an average high price for hauling. Generally, it is considerably lower. It is used to be conservative and rather as an illustration of figuring costs than to be fully representative.

The costs given are those up to loading on cars at the railroad or to delivery to local markets.

Average prices for the other items of cost are given. These can be modified in any given case.

Cost of Producing Lumber.

	Per M. bd. ft.
Cutting	$1.50
Skidding	1.75
Sawing	3.50
Piling	1.00
Hauling	5.00
	$12.75

Cost of Producing Ties. Ties are often hewn at a cost of about 10 cents per tie. Hewing is wasteful, especially in large-sized trees. Ties may be sawed on two or four surfaces.

Generally 33 first-class ties or 38 second-class ties will average about 1,000 board feet of lumber.

	First class	Second class
Cutting	$0.045	$0.039
Drawing to mill	0.045	0.039
Sawing	0.090	0.075
Peeling	0.010	0.010
Hauling	.160	0.130
	$0.350 per tie.	$0.293 per tie.

Ties are 8 or 8½ feet long. First-class ties are 7 inches thick, and not less than 7 inches or over 12 inches wide at any place on the face, and must be hewed or sawed on two faces. They are sometimes allowed to be sawed on four sides, and then to be 7″ x 9″.

Cost of Producing Poles. Poles are generally peeled and cut to come in one of two classes given in the specifications under products — the most common sizes are seven inches inside the bark at the top.

Poles cut in winter cost a little more to cut than in summer, but are preferred, because they are less likely to rot.

Frequently a cent a foot is charged per pole — that is, a 25-foot pole would cost 25 cents. Poles from 35 to 50 feet long are cut and peeled for 35 cents.

	25–30 ft. poles (6 poles per load)	35 ft. poles (4 poles per load)	40–50 ft. poles (2 poles per load)	60 ft. poles (1 pole per load)
Cutting	$0.25	0.35	0.35	0.35
Hauling	0.83	1.25	2.50	5.00
Per pole	$1.08	1.60	2.85	5.35

Cost of Producing Cordwood. The average cost of cutting and stacking cordwood for burning is about one dollar per cord. Where oak and hickory predominate the cost will be higher.

An ordinary load is about 1 to 1½ cords.

This would make cordwood cost $6 per cord to cut and haul. It would be unprofitable where the haul was six miles or over, for only one cord could be drawn per day, at a cost of $5 for a team.

Cost of Producing Charcoal. Where the only product available is cordwood, and the distance is too great to haul profitably, the wood may sometimes be burned into charcoal on the tract, and this profitably marketed.

The cost of this is:

Cutting wood and hauling to hearth	$1.00
Building and filling kiln ready for burning	.32
Collier's wage, per cord	.75
Hauling to railroad, loading on cars	.75
	$2.82

This will make 600 pounds, or 34 bushels of charcoal at a cost of about 8⅓ cents per bushel.

Generally, at least twenty cords of wood should go into an ordinary kiln. Where several kilns are burned at once, the cost of burning is reduced considerably, as one man can watch them all as easily as he can one.

VALUE OF STANDING TIMBER — STUMPAGE VALUE

Knowing market prices and costs of getting his material to the market, the owner is in a position to place a value on his standing timber. This value of standing timber is called its "Stumpage price." Where he does his own lumbering, the stumpage value might be considered the difference between the cost of marketing the product and the market price. This, however, is hardly a fair value. Each step should be considered separately, and a fair allowance should be made for each.

Method of Computing Value of Standing Timber. The lumbering being a manufacturing operation, it is only fair to allow about 20 to 25 per cent net profit on the work; and figure the real stumpage value as the market price, less the cost of lumbering and the profit of lumbering (20 per cent. to 25 per cent. of the cost). That is, stumpage value is the difference between market value and the sum of the cost of lumbering plus profit of lumbering. Then, if the owner does his own lumbering, the stumpage value and profit in lumbering will both be his.

Average Stumpage Value for Different Products. On the basis of costs given above for marketing the product, stumpage values would be as follows:

Lumber:

	Per M. bd. ft.
Average value of lumber "Long Run"	$25.00
Cost of lumbering $12.75 + 25% profit	15.94
Stumpage value	$9.06

Ties:

	First class	Second class
Average value	$0.56	$0.50
Cost of lumbering and profit (25%)	0.44	0.36
Stumpage value	$0.12	$0.14

Poles:

	25–30 ft. Poles	35 ft. Poles	40–50 ft. Poles	60 ft. Poles
Average value	$2.50	$4.00	$6.00	$9.00
Cost of logging and profit (25%)	1.35	2.00	3.56	6.69
Stumpage value	$1.15	$2.00	$2.44	$5.31

Cordwood:

Average value $4.00 for chestnut, and similar wood.
5.00 for oak.
6.00 for hickory.

At the rate of hauling, used in these figures, the value of the wood standing, as far as cordwood goes, would be nothing, as it would be a losing proposition to try and market it.

Charcoal: As noted, under such circumstances, it may pay to burn the wood into charcoal on the tract. This gives a lighter and more valuable product to haul.

Average value 34 bushels charcoal (from 1 cord of wood)	$3.40
Cost of logging and profit (25%) on 34 bushels	3.51
Stumpage value 1 cord of wood	$0.10

Under the above theoretical conditions, it will be seen that selling cordwood, the owner would lose $1 a cord, and converting it into charcoal would still be at a net loss of ten cents a cord, allowing 25 per cent. profit. However, allowing 20 per cent. on the operation, at 10 cents a bushel for charcoal, the owner could come out even, where he would lose money trying to sell as firewood. This sometimes is important in figuring on a pure improvement cutting, or in clearing land after fires, etc. As a general rule, the market for cordwood is closer at hand — mostly at home.

AVERAGE STUMPING VALUE FOR DIFFERENT PRODUCTS. For convenient reference, taking in consideration ordinary conditions through the State, in woodlots fairly well stocked and in from fair to good condition, the following stumpage value will give an idea of actual value, or of what should be a fair value for stumpage.

Cordwood for firewood, 50 cents to $1 per cord.

Ties, 8 cents to 12 cents per tie.

Poles, $1.25 for 30 ft. pole.

Lumber, $6 to $10 per thousand board feet.

Average Stumpage Value for Woodlands of Different Sized Average Trees. Stumpage per acre in well-stocked stands of different average sized trees will be about as follows:

Stands averaging	Value per acre.
4 inches diameter	$15.00
6 inches diameter	25.00 to $30.00
8 inches diameter	35.00 to 50.00
10 inches diameter	40.00 to 65.00
12 inches diameter	45.00 to 85.00

V. TABLES

I. AVERAGE CONTENTS OF TREES OF DIFFERENT DIAMETER CLASSES IN BOARD FEET *

Diameter breast high	Chest-nut	Red oak	White oak	Ash	Beech	Birch	Hard maple	Hem-lock	White pine	Spruce
Inches	*Contents in Board Feet*									
8	.....	.....	.....	.....	.....	.....	.....	30	45	40
9	15	15	15	15	12	.....	6	45	60	55
10	30	30	30	30	25	18	20	65	80	70
11	45	45	48	50	40	31	37	90	110	90
12	65	60	68	70	60	48	55	115	140	112
13	90	85	95	95	81	65	73	145	175	135
14	115	110	122	125	106	78	98	180	210	160
15	140	135	150	155	135	105	127	220	250	190
16	170	165	180	190	168	127	158	260	295	220
17	200	195	210	225	205	151	190	300	350	255
18	230	225	240	260	242	180	222	350	400	295
19	265	260	275	295	280	216	255	400	455	335
20	300	295	310	335	325	255	295	460	510	380
21	340	335	350	386	375	298	340	520	565	430
22	380	375	390	430	440	343	394	580	620	485
23	425	415	435	485	500	387	455	645	680	545
24	470	460	480	540	576	431	525	710	740	610

NOTE.— Chestnut table can be used for basswood. White oak table can be used for hickory.

* No allowance has been made for rots, or other defects, as these vary so much in different situations. Especially in beech, birch and maple over sixteen inches diameter, the amount of rots and other defects will generally reduce the contents by at least 10 per cent.

All the tables given can be counted on only for rough estimates, as they have been generalized to an approximate average of conditions throughout the State, and will not be correct for any given locality. Beech, birch, maple, spruce and hemlock tables are constructed entirely from original data; the others from studies by others, modified for wood lot conditions in New York State.

Other tables will be found through the text, as follows:

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Statistics of land use and woodlot conditions, New York State 9
Resistance of different kinds of trees to drought 20
Requirements of trees with regard to soil moisture 21
Tolerance of shade by different trees 25
Requirements of trees with regard to soil 27
Characteristics of tree as to rate of growth 28
Number of trees per acre in well-managed stands of different sizes 58
Growth per acre per year, in well stocked stand 81
Prices and specifications of poles 91
Cost of producing lumber 97
" " " ties 97
" " " poles 98
" " " cordwood 98
" " " charcoal 98
Average stumpage value for various products 99
Average stumpage value for woodlands of different sized average trees 100

II. NUMBER OF TREES OF EACH SIZE REQUIRED TO YIELD

Diameter breast high	ONE CORD				ONE THOUSAND FEET OF LUMBER			ONE TIE	ONE POLE	Diameter breast high
	Popple	HARDWOODS		Soft-woods	HARDWOODS		Soft-woods	Hard-woods‡	Hard-woods§	
		Northern	Southern		Northern*	Southern†				
	NUMBER OF TREES									
Inches									(One pole of length noted, per tree) (Length of pole secured) *Feet*	*Inches*
2	....	....	170	....	....	....	....	....		2
3	....	....	90	....	....	....	....	....		3
4	....	....	50	....	....	....	....	....		4
5	50	35	25	....	....	....	....	....		5
6	25	20	17	....	....	....	....	....	....	6
7	16	15	13	20	....	....	....	....	....	7
8	11	11	9	13	....	....	25	....	....	8
9	7	8	7	10	85	66	20	....	....	9
10	6	6	6	8	45	33	15	1	....	10
11	5	5	5	7	28	22	10	1	....	11
12	4	4	4	6	19	13	8	.5	25	12
13	3	3.5	3.4	4.5	14	11	7	.5	25	13
14		3	3	3.7	11	9	6	.3	30	14
15		2.5	2.5	3	8	7	5	.3	35	15
16		2.0	2.2	2.5	7	6	4	....	40	16
17		1.7	2.0	2.1	6	5	3.1	....	40	17
18	Trees per cord of peeled wood	1.5	1.8	1.9	5	4.5	2.6	....	45	18
19		1.3	1.5	1.6	4	4.0	2.4	....	45	19
20		1.2	1.3	1.5	3.5	3.3	2.1	....	45	20
21		1.0	1.2	1.4	3.1	3.0	1.8	....	50	21
22		.9	1.1	1.2	2.7	2.7	1.7	....	55	22
23		.8	1.0	1.1	2.3	2.5	1.6	....	55	23
24		.7	.9	1.0	2.0	2.2	1.5	....	55	24

NOTE.— Softwoods, to 4" top diameter. Northern hardwoods: beech, birch and maple to 4" top diameter. Southern hardwoods: chestnut, oak, hickory, basswood, ash, etc., to 3" top diameter.

* For every thousand feet of lumber about two-thirds of a cord of wood can also be cut.

† For every thousand feet of lumber about three-quarters of a cord of wood can also be cut.

‡ For every ten ties about one cord of wood can also be cut.

§ For every ten poles about one cord of wood may be cut also.

CONTENTS OF LOGS IN BOARD FEET

The most common rule in New York State for measuring the contents of logs in board feet is the "Doyle Rule." This is especially common in measuring hardwood logs. It gives extremely low values for small logs, such as the average sized logs from the woodlot, and the seller of such logs gives a much greater quantity than he is paid for.

To get the contents as given by this rule:

Measure the diameter of the log in inches (usually this is measured inside the bark, at the small end, but a much fairer result is obtained by using the average of the diameter of each end of the log); from this diameter subtract four; divide this amount by four; square this result; and multiply by the length of the log. This gives the contents in board feet by Doyle Rule.

Thus: Diameter of log in inches, as measured, is 14.
Substract four, leaves 10 (Diameter in inches minus four).
One-fourth of 10 is 2.5 (one-fourth of above result).
2.5 x 2.5 is 6.25 (square above figure).
Length of log is 10 feet.
10 x 6.25 is 62.5 (above result by length of log).
Contents of log in board feet is 62.

Various other log rules are used to give the contents of logs in board feet. The fairest of these is the International Rule, made by Dr. Judson F. Clark. A modification of these for woodlot conditions in New York State is given below. No allowance is made for defects, which must be figured separately for each case.

III. TABLE SHOWING CONTENTS OF LOGS IN BOARD FEET.

DIAMETER OF SMALL END INSIDE-BARK	LENGTH OF LOG IN FEET				
	8	10	12	14	16
	Contents in board feet				
Inches					
5	5	5	9	13	13
6	9	9	13	18	18
7	13	13	18	22	27
8	18	22	27	31	40
9	22	27	36	45	50
10	27	36	45	54	63
11	35	45	59	67	79
12	45	58	68	81	94
13	53	67	81	99	117
14	63	81	99	117	135
15	72	94	112	135	157
16	85	108	130	153	180
17	94	121	148	176	202
18	108	139	166	198	229
19	121	158	189	225	261
20	135	175	211	247	288
21	153	193	234	274	319
22	166	211	256	306	351
23	184	234	283	333	387
24	203	256	310	364	423

Other ways of getting contents of logs in board feet are:

Measure diameter, in inches, of small end inside bark; square this number; multiply result by .785. This gives area of base of log. Multiply by length of log in feet, and divide by 12, giving contents in board feet. This is the principle of the Constantine Rule. This gives almost the solid contents of the logs. To allow for waste in sawing, deduct about one-fourth of the result above given, and a fair value for the contents is secured; if anything, this value is apt to be too high.

Another way often used is to get contents in Standards, by use of the Standard rules, and then allowing 200 board feet per Standard.

CONTENTS OF LOGS IN STANDARDS

In Northern New York, especially for softwoods and popple, the most common rule used is the so-called Standard Rule. By this rule the contents of logs are given in their proportion to the contents of a log 13 feet long and 19 inches in diameter inside the bark at the small end. Generally it is considered that three standards make one cord of wood; and five standards make a thousand board feet of lumber.

To get contents in Standards:

Measure diameter in inches inside bark at small end.

Square this number.

Divide above result by 361.

This gives contents of all logs 13 feet in length.

For other length logs, add or subtract 1/13 of contents as secured above, for each foot that the log is more or less than 13 feet long.

As an interesting example of the great variation in contents as given by different log rules, the example of the log 10 feet long and 14 inches in diameter at the small end is given.

Log Rule	Contents in Board Feet.
Doyle	62
International (Modified)	81
Constantine (with ¼ allowed for waste)	96
By 19 inch Standard, (allowing 200 board feet per Standard	84
Actually sawed out of ten logs (average)	85

In smaller logs, the differences would be even greater. This but illustrates the necessity of specifying the log rule used, if sale is to be by board foot measurement of logs.

LIST OF PUBLICATIONS ISSUED BY CONSERVATION COMMISSION GIVING INFORMATION IN REGARD TO FORESTRY

Bulletin 1. *General Forestry.*—A discussion of the value, and meaning of forestry. Suitable for teachers and general reading.

Bulletin 2. *Reforesting.*— Instructions, how and when to reforest land, with statements as to profit.

Bulletin 3. *The Basket Willow.*— How to plant an ozier holt and produce basket willows.

Bulletin 4. *The Forests of Oneida County.* A description of the forests and information as to methods of forest management that should be applied.

Bulletin 5. *Outline of Forestry Lectures.*—A synopsis for preparing a lecture on forestry for students, clubs, granges, etc.

Bulletin 6. *Forests of Warren County.*— Report on forest conditions and advice as to better management.

Bulletin 7. *Shade Trees.*— Suggestions as to planting, care and uses of trees for streets and highways.

Bulletin 8. *Forest Taxation.*— Synopsis and text of laws relative to reduction and exemption from taxation of woodlots and reforested lands.

Bulletin 9. *Woodlot Forestry.*— Discussion of principles and advice how to best handle farm woodlots and forests on small estates.

Bulletin 10. *Forest Fires.*—The forest fire problem, and methods of handling forest fires. (In preparation.)

These publications will be supplied to residents, free, on request, as long as a supply is available.

A map of the forest sections of the sixteen Adirondack counties, showing lines of travel, drainage, land allotment and State land, scale two miles to an inch, in portfolio form, will be sent to anyone post paid on receipt of one dollar.

A map of the forest sections of four Catskill counties, similar to that of the Adirondacks, will be sent to anyone post paid on receipt of one dollar.

Walter Mulford

Statement of Hon. George E. Van Kennen, Chairman of the Conservation Commission, State of New York, before the Joint Judiciary Committees of the Senate and Assembly, on the Water Storage Bills, Albany, N. Y., February 29, 1912.

Mr. Van Kennen said:

Most of the discussion we have heard thus far with reference to these bills has been directed to the measure which provides for the creation of a so-called quasi-public corporation. I think that we ought to discuss the features of the bill that is before this Committee, providing for an amendment to the Conservation Law, and I shall direct all my remarks to that bill and shall present to this committee a so-called substitute or amendment, if you please, or suggestions with reference to what we would like to have put in that bill.

We do not care to be recorded as opposed to the bill, but with the suggestions and amplifications that we expect to present to you, we think that the measure might be put into workable shape.

We have approached this question purely from the standpoint of conservation, understanding that to be one of the functions of our Commission. Our predecessors and our Commission have spent much time in research in order to determine what the so-called undeveloped water powers of the State consist of. In other words, we have endeavored to ascertain how much real undeveloped water power there is in the State to-day. We are not speaking of those water powers where there are at present wheel installations, but we are taking into consideration only those water powers that are absolutely undeveloped. We have classified them so as to bring to the attention of this Committee what we think is important in order to determine what should be done with reference to the bills before you, and I will describe a little in detail the undeveloped water powers of the State of New York.

Undeveloped Water Powers of Two Kinds.

We have classified them so as to show exactly what undeveloped water powers the State itself owns. In other words, we are presenting to you now a classification of two kinds: one, the so-called State-owned undeveloped water powers; and we shall also present those water powers where there are some private interests, as, for instance, riparian interests or interests granted by the Legislature. The powers that will be created by the barge canal construction at Lockport, Rochester, Fulton, Hinckley, Vischer's Ferry, Crescent and Waterford, aggregate approximately 85,000 horsepower that may be developed at those points. There is probably more than that, but a conservative estimate shows that on the barge canal, when completed, there will be at least 85,000 horsepower that is available.

According to the figures that we present here, if we develop some of the storage projects that have been suggested, as, for instance, the Genesee and the Sacandaga and the Black river development, we shall have at the place of the storage reservoir, if discharged in accordance with a way which will give the most power at that place, at Portage practically 39,000 horsepower; at Sacandaga, 42,000; and at the Black river, roughly 3,000; aggregating 84,000 horsepower.

I may say with reference to the development of water powers at these reservoirs, that our project contemplates the construction of these reservoirs by the State itself, consequently we hold that any power that may be generated at those points necessarily belongs to the State. So that at the discharge points of these reservoirs we shall have about 84,000 horsepower.

In addition to that, the water powers belonging to the State, arising from its ownership of the beds and banks of streams, and under its rights as riparian owner, are considerable. The State is the riparian owner itself of a large amount of undeveloped water power. It is assumed, and I believe admitted by everybody, that so far as the waters are concerned, if it owns the bed of the river, it may be developed as belonging to the State itself. Below the rapids at Niagara Falls it is estimated that 145,000 horsepower may be developed. That has no reference whatever to the present development there, but is a development made possible by the fall of the stream below Niagara Falls. At Kettle Mountain on the Hudson, where there is ownership by the State of the bed and the banks of the river, there is 28,000 horsepower. At the Sacandaga river, above Northville, owning the banks and the bed, there is 31,200 horsepower; at Ausable river, 10,000; at the Indian river, 14,000; making a total of 228,700 horsepower.

Our figures have been based in some cases where there is a constantly developed power upon 24 hour power, 365 days in the year. In no case have we given any figures that would not yield power upon what we call an economical basis of installation, which is practically a plant that will run at full capacity 60 per cent. of the time. In other words, if you have a water power site, as we have figured this, you can afford to install turbines to such an extent that the last one can be run 60 per cent. of the time. Sixty per cent. of the time is considered by engineers, I am advised, as being the maximum limit of profitable installation on most rivers.

THE STATE ABSOLUTELY OWNS FOUR HUNDRED THOUSAND H. P.

None of the figures are less than I have stated, so that by reason of its ownership of the beds of the stream, etc., we have in addition to what we have at the storage reservoirs and in the canals, an additional sum of 228,700 horsepower, which makes approximately 400,000 horsepower that belongs to the State, which I do not think anybody will dispute, under the scheme that we suggest.

By the regulation of the stream, there is an additional created power; in other words, if you build a reservoir at Sacandaga and discharge that water, there will be a created power at the water power sites below, so that in speaking of that we claim that the power being created by the State itself should belong to the State, but it is subject to the criticisms that have been discussed here today. Anyway, it is power that the State creates itself, therefore we have classified it as undeveloped waterpower, created in this way. The following are the amounts added at power sites where there are now no developments at all, not a wheel running; on the Hudson, 20,000; on the Genesee, 9,000; on the Black river, 5,300; on the Raquette river, 23,400; on the Oswegatchie river, 5,000; making an aggregate of 62,700.

Senator Bayne: — Is this last owned by the State or by individuals?

Commissioner Van Kennen: — We are speaking about the power added at undeveloped waterpower sites along streams where there are riparian interests, but it is a created power, an additional power over and above what is there now, by reason of the regulation of the stream. In other words, if the State undertook the regulation of the stream, it would create that amount of power in those undeveloped places.

At waterpower sites now developed, we would have on the Hudson river, 75,900; on the Genesee, 10,000; on the Black river, 25,000; on the Raquette river, 12,600; on the Oswegatchie, 7,000; making a further aggregate of 130,500.

Mr. Baldwin: — That is not a 365 day power.

Commissioner Van Kennen: — Sixty per cent. of the time. A large amount of what I am giving you is continuous power, and none of it is less than 60 per cent. of the time.

That is the addition that is created by the regulation over and above the now developed horsepower. In addition to that we have a classification of undeveloped horsepower where there are outside interests, as, for instance, grants by the State given to certain power owners. We have tried to figure the amount of it. They are undeveloped; nothing has been done except that somebody has gotten a development grant, such, for instance, as the Long Sault, and there are many others. They are undeveloped and consequently we are classifying them as undeveloped horsepowers. We have on the St. Lawrence, 500,000 horsepower. It is probably more, but we estimate it at that. On the Niagara river there is 4,400 cubic feet per second which is now in suspension, so to speak. It is that portion that is not used but which is permitted to be used by the treaty between the United States and Great Britain. We claim it as belonging to the State. We claim it as undeveloped power, but there are grants to private corporations, and those grantors claim it also; so there is a question about ownership; but it is undeveloped. On the Upper Hudson there is 90,000; on the Raquette, 120,000; on the Genesee, 8,000.

At Least 1,385,300 Undeveloped H. P.

This makes a grand total of undeveloped horsepowers in the State of New York of at least 1,385,300 horsepower. About 400,000 horsepower of that is absolutely owned by the State; nobody else has any interest in it; no challenge of the title. The balance is somewhat in dispute, but it is all undeveloped. For instance, the Long Sault people say they own this 500,000 horsepower by reason of a grant made by the State of New York, but there is not a wheel installed, nor has a single thing been done there toward the development of that power, and I have classified it as undeveloped power of the State.

I have gone at some length into this matter in order to determine if possible what policy the State should adopt with reference to this. We have, as I have said, that vast amount of undeveloped horsepower, and the next interesting question would be, how much power is used in the State of New York? I must confess that upon this particular question there is some doubt. Our information is not absolute in regard to it. We have gotten the best information that we can. For instance, we took the report of the census, but in those cases you always get the amount of horsepower that is installed, not the amount of horsepower that is actually used, so that while the census report might show that there was 3,000,000 horsepower actually installed in the State of New York, that does not show that there is 3,000,000 horsepower actually used.

Senator Ferris:—It also is confined mostly to manufacturers, isn't it ?

Commissioner Van Kennen:—Our data is insufficient as to locomotives, or anything of that kind. I am speaking about the business interests of the State. While the data seems to show that there is installed power in the State of New York to-day amounting to approximately 3,000,000 horsepower, it is pretty nearly safe to say that there is less than 1,500,000 that is actually in use. We have tried to get some information upon that question by inquiring of those people who furnish power, to get a comparative statement of the amount of installation in particular localities, and the amount of power that is being used, and we find in most cases that they are in the proportion of three to one, ordinarily at least two to one, so if that is so, you would have less than 1,500,000 horsepower actually used.

I have shown you that we have as a conservative estimate approximately 1,500,000 undeveloped horsepower in this State, so you reach the conclusion that if you could utilize the undeveloped waterpowers of the State of New York, you could turn every wheel in the State, outside of locomotives.

SURPLUS CANAL WATER.

We have studied the matter and we have wondered, for instance, what you could do with the waters on the canal. It is perfectly patent that if we want to conserve them, we have got to use them in some form. You have either got to lease those waters or else you have got to distribute them in some form. The State has in the past leased canal waters and I will speak particularly of this. We have had some experience in it. I think, if I am not mistaken with reference to the figures, we are now taking in for all the surplus canal waters of the Erie canal less than $2,000 a year.

Mr. Baldwin: — Two hundred and ten dollars last year.

Commissioner Van Kennen: — There are one or two persons that have sent in their money which we have not accepted, but it will not amount to $2,000. The peculiar thing about that is that they claim that they are entitled to all the surplus power, and they are using it so far as they can use it. The difficulty is that there are leases outstanding to-day that were made back in 1826, when the canal was only about four feet deep and they claim that they have perpetual rights under them. They claim that no matter whether we build a barge canal or a ship canal, they are going to have that power. It is time that we understood where we are at on this proposition.

Senator Bayne: — Has any action been brought to test these rights?

Commissioner Van Kennen: — No; so far as I know, there has been no action brought to test the rights.

Commissioner Moore: — The water is resumed by the State at Lockport.

Commissioner Van Kennen: — They had to because they were using it to build the barge canal, but they claim the right to resume. The State claims it has the right to resume these waters.

Commissioner Moore: — They made a formal resumption.

Senator Wainwright: — What is the nature of these grants?

Commissioner Van Kennen: — The authority was by statute which said that the Canal Board might lease the surplus waters of the canal. This is interesting because we are going to have available practically 100,000 horsepower, and if we are going to adopt the plan of leasing, we are coming down to that particular proposition.

Senator Bayne: — Are these leases perpetual?

Commissioner Van Kennen: — They claim they are; I don't think they are. What is more, I don't think that any lease in any form, that was made when they could only develop 60 horsepower at a given point will go along with all the changes and variations that take place. With the increased power they have something like 4,000 horsepower.

Commissioner Moore: — Nine thousand.

Commissioner Van Kennen: — Nobody would pretend that at this time you ought to draw a lease extending the time beyond a period of 25 years. I think if the Legislature or anybody else attempted to draw a lease for a longer time than that, for the use of these waters, they would be subject to criticism, as giving a longer period than we ought.

7,000 OR 8,000 AVAILABLE H. P. IN THE SHADOW OF THE CAPITOL

We have 7,000 or 8,000 horsepower almost under the shadow of the Capitol that can be available 60 per cent. of the time, which is an economically feasible proposition, and which would cost us not more than $40 or $50 per horsepower for the capital cost of its development. Assuming that we undertook to lease that to somebody; the lease would be for 25 years with chance of changing the rental, we will say, at ten years. What has he got to do? He can't use it there; he must necessarily use it somewhere else. He must construct his hydraulic development, wires and transmission lines. I do not think it would be feasible, nor do I think that you would find anybody that would enter into that kind of an enterprise, so that when you come to talk about leasing these waters, in my opinion, you would get nothing for them on the basis that we have been discussing.

I have discussed the question of the impracticability of the leasing of canal waters. I want to touch for a moment upon what I would call the impracticability of the development or the conservation, if you please, of waters by private interests on streams. Take, as an illustration, the Hudson. It would be much better, and probably more illuminating, if you were to take some other stream, because we have heard the Hudson discussed so much that I would like to get your minds on to some other stream, such as, for instance, the Raquette, where there is a considerable amount of power that might be developed. The difficulty there has been that they never could develop that stream by voluntary act on the part of the riparian owners. They won't agree. There would be some fellow that would say "If you want to develop it, go on and develop; all the water will run over my wheels just the same." They can't agree upon the cost; they have no power of eminent domain, and therefore they can't go and take another man's property for the development of their property. So it is absolutely impracticable for the riparian owners to attempt to develop the water powers on the streams themselves. It is impossible; they can't do it. There is no law in the State that I know anything about that will permit it. There may be upon the stream a dozen or fifteen riparian owners, and in order to develop that stream they have got to take private property for reservoirs. They have got to flow the private lands of somebody else. You can't under any provision of the law that I have ever known, go up and take that private property, including burial grounds, etc., in order to develop power for the use of these dozen or fifteen owners below.

Therefore I say it is impossible to do it upon the initiative of the owners themselves; it can only be done, as I believe, by the State upon some basis that will justify the taking of it. I don't think the State could do it under all circumstances, but it might do it for some purposes. Therefore we come to the suggestions contained in our bill.

STATE DEVELOPMENT FOR THE ULTIMATE CONSUMER.

Our idea is that if you can find a purpose that will justify the taking of one man's property for everyone's use, then you can take the property and make these developments. It has occurred to us that it is a proper thing for the State itself to develop these undeveloped water powers for the purposes of distribution to municipalities, so that the ultimate consumer would get the benefit thereof in the lighting of public streets and public buildings, domestic lighting and commercial lighting, and for municipal power and for all other municipal purposes, which would carry with it the right of eminent domain to acquire and develop all this property, and, incidentally, for power purposes. That is practically the proposition and I think it is the only feasible one— the only one that can be carried out. Develop these water powers; transmit them to the municipalities; turn them over to the municipalities for their own public uses. That makes it a public use, and when you make it a public use, then it will carry with it the right to take property.

We have, therefore, suggested that this bill be amplified so that it will give this Commission the widest possible powers in order to acquire any water powers, water power rights, water power developments, electrical developments, or any other property proper or necessary in order to carry out this scheme.

Senator Bayne.— In the judgment of the Commission?

Commissioner Van Kennen.— Whatever the Commission may deem is necessary.

Senator Ferris.— The theory is so that the ultimate consumer wil get the greatest benefit, and that the development, transmission and sale to the municipalities shall be at a sum which is sufficient to cover the cost and the contingent expenses of line loss, etc.

Assemblyman Crandell.— You mean that the State shall use its power of condemnation for a public use, which public use is the public use of a lesser political division?

Commissioner Van Kennen.—That is it exactly; the municipalities get the light and everything else. The State develops it, transmits it to the municipalities; the municipality takes it and distributes it to the people.

Senator Black.— Does that apply to municipalities or mercantile establishments?

Commissioner Van Kennen.— It applies to mercantile projects. The municipality disposes of it to the individual corporation.

Senator Black.— Your idea was to sell to the individual for commercial purposes or otherwise?

Commissioner Van Kennen.— The leading idea is to conserve this power for public purposes, and for power purposes; it must be universal and without discrimination, and at the same price.

Assemblyman Crandell.— No discrimination in other municipalties as against manufacturing concerns?

Commissioner Van Kennen.—All fixed by the Commission; no discrimination whatever.

Senator Ferris.— As I understand it, it is like this. You would pick out a political subdivision, as, for instance, a city, and you would make your contract with the city. They would act as the distributing agent and they would make the contract with the individual users of electricity within the city. Going a step further, they could go to a town and make a contract with the town and the town would act as a distributing agent and make the contracts with the individuals in the town. You would not make the sale to a manufacturer or to an individual user, but you would sell to a political subdivision, and they in turn would sell whatever electricity might be needed.

Commissioner Van Kennen.— There is a provision in our proposed law which says, for instance, if a street railway company should come to this commission and want power for its public service uses, we could sell it to them and it would all inure to the benefit of the municipality because it reduces the ultimate charge to the municipality. The expense is on the municipality.

Senator Ferris.— Excepting the transmission to the municipality.

Commissioner Van Kennen.— We could step into Niagara Falls and have 100,000 horsepower. We would want to serve

Buffalo, Lockport, Medina, Rochester. We would then build a transmission line from Niagara Falls, to, we will say, Rochester. The contract would be that they should pay their pro rata share of the cost, to produce a sinking fund to amortize the cost of the investment, with the up-keep, repair, maintenance, etc.— each individual municipality. That is the general theory of our scheme.

MAXIMUM PRICE FIXED TO PREVENT INEQUALITIES.

The Commission fixes the maximum price that may be charged by a municipality to its consumers, because otherwise there might be inequalities arising, as to different classes of service, so that it is left with the Commission to make that determination. I will speak of that a little later.

Senator Bayne.— What will you do in case the power owner or riparian owner has rights which are affected?

Commissioner Van Kennen.— The problem of the regulation of a stream doesn't amount to much in the scheme that we have here; it is only a small percentage of it. It amounts to something; but you can easily see from the figures that I have given, so far as the riparian owner is concerned. that the amount of increased power is a small amount compared with the entire undeveloped water powers of the State, so that it becomes more or less negligible.

We make these provisions: The State itself has to put up the money for these improvements. We have the power at the foot of the reservoir to use just as we like. We would say to the power owner; "We are increasing your power so much, over and above what you have according to the regular flow of the stream." For instance, on the Hudson it will be 60,000 horsepower over and above what they would have if there were no improvement upon that stream. We would like to have you pay for it." Some would say, "I don't want it." Most of them will want it; that is our theory. But supposing we find some person that doesn't want it; won't pay for it. Then under our broad general powers of condemnation, we would have the right to take that property and develop it ourselves, or we would have the right to take any part of it. We can take the flood waters, for instance, under our bill. There may be some little engineering difficulty in regard to separating the flood water from the other water. We would have the power under this bill to acquire it and develop it at the site. The damages to the owner are nominal; it amounts to little or nothing because we are only taking what we have created.

Our theory is that, for instance, by the Sacandaga improvement, and the regulation of that flow, we increase the power that is already there from the natural flow of the stream by 60,000 horsepower. That would give each one so many horsepower increase. I am speaking now of the maximum unit of feasible development. He gets that addition; if he wants to buy it, he buys it. We could develop that additional amount ourselves. In some instances that additional amount is 10,000 horsepower that could be used for sixty per cent. of the time, which is, in and of itself, a feasible commercial development. But if we should develop power on one of these streams where they would not enter into any contract at all, and we wanted it all, we can take all the power.

Senator Ferris.— The amount you take would depend upon the market?

Commissioner Van Kennen.— Depend upon what we wanted.

Senator Bayne.— Suppose none of these gentlemen would consent?

Commissioner Van Kennen.— Then there probably would be little or no development on a stream of that kind; in other words, if we want to develop that stream and our scheme should necessitate the development of all its powers, we don't need to ask anybody about riparian rights. We can exercise the rights that we get by the Legislature and condemn the rights of those that the State has given away by grant, if we have to condemn them.

Senator Bayne.— Where would you get the money?

Commissioner Van Kennen.— From State appropriations.

Senator Bayne.—You would run up against the $1,000,000 limit?

Commissioner Van Kennen.— That depends altogether upon the appropriation; it might require a referendum.

Senator Bayne.— It depends also upon the discretion of the Commission; they can regulate, as to the necessity.

What Could be Done with $5,000,000.

Commissioner Van Kennen.— With $5,000,000, which is no more than the amount that is being appropriated for a single prison, we can build transmission lines from the St. Lawrence river to Binghamton, and from Niagara Falls to New York, without any doubt; so that it is not a matter to worry anybody financially.

Senator Ferris.— As a matter of fact, the development of transmission lines will all depend upon the market.

Commissioner Van Kennen.— To a certain extent.

Senator Ferris.— You would not build a transmission line for any more than a municipality wanted ?

Commissioner Van Kennen.— If we had 50,000 horsepower available at some point by development or otherwise, we would begin to get the municipalities interested, and find how many will take power, and then go on and build our distribution plant in accordance with that, until finally it was carried throughout the State.

Senator Ferris.— For instance, you would make a contract with the city of Schenectady for whatever amount they would take, which would be whatever they had a market for, at cost.

Commissioner Van Kennen.— What the municipality thought they could dispose of.

Senator Ferris.— Your plan contemplates, does it not, that the price to the ultimate consumer, or the manufacturer, would be very much less than that at which it is now being furnished ?

Commissioner Van Kennen.— Yes.

Senator Ferris.— Whatever can be saved to the ultimate consumer, of course, would be saved.

WHAT THE CANADIAN PLAN DOES.

Commissioner Van Kennen.—At the last hearing a gentleman from Rochester, Mr. Hutchings, spoke of the Hydro-Electric Commission's work in the province of Ontario. I am frank to say that these bills, to a certain extent, safeguard the interests that I do not think they safeguard over there. Anyway, he made the remark that the Hydro-Electric Commission over there is very popular for the reason that it furnishes light for the people cheap, and makes the concerns that are using it for power pay more for it than it is worth. We took the standard figures given in Canada, that they give for these different services, and compared them with what they served the people in Rochester for, and we find this result: In Rochester, if you apply the prices that are charged by the Hydro-Electric Commission, the users of municipal street lighting at that place would annually save $56,160, and the users of power would annually save $78,700. The users of light would only save $6,270, so that so far as his criticism is concerned, it is not borne out by his own statement. The aggregate saving is $141,470 per annum, using the prices that the Hydro-Electric Commission furnish to the municipalities in Canada.

Senator Ferris.— So that it is entirely obvious that if you went to Rochester, you would get the business.

Commissioner Van Kennen.— And we would get the power business, too. In Albany, for instance, there would be a saving, upon the same comparison, of $154,900 per annum.

Senator Ferris.— Bringing the power from anywhere ?

Commissioner Van Kennen.— Selling the power at prices standard where they are carrying the power 300 miles over high tension wires.

Senator Ferris.— You could bring it from Niagara.

Commissioner Van Kennen.— So far as Albany is concerned, the commercial lighting seems to be the one that pays the most because the saving would be $73,100, while the power saving would be only $32,100. In Troy the municipal street lighting would save $38,300 and the commercial lighting would save $57,100 per annum. The power would only save $15,000 per annum. Syracuse would save in the aggregate $225,000; municipal street lighting save $42,000; domestic lighting, $145,000; and power, $33,500.

In some cases we were unable to get figures because we had to take them from the reports filed here and they did not classify them in such a way that we could get the ones wanted. At Watertown, for instance, on the Black river, where the question of power is very tense, and they are very much interested in it, the annual aggregate saving would be $37,180. So far as lighting is concerned, they would save $29,900; so far as power is concerned, they sell their power up there cheaper than they do in Canada. That comes about by competition in the power districts. When it comes to power, they sell it for less than they do under the scheme that we are speaking about.

Senator Bayne.—And still make money ?

Commissioner Van Kennen.— I don't know whether they do or not.

Senator Loomis.— Have you any figures regarding Buffalo ?

Commissioner Van Kennen.— We could not get those classified for the reason that they were not in shape so that we could get them. We could not make a safe comparison.

Senator Bayne.— Does the Ontario scheme involve the proposition that one interest is sacrificed for the benefit of the other?

Commissioner Van Kennen.— It is supposed to be upon a scientific basis, figured out as scientifically as possible, and must be approved by the Commission, after it has determined as to the schedule of rates fixed. They figure upon how much the service for light ought to be worth, how much the service for power ought to be worth, and how much for street lighting, for store lighting, for all other given services, and try to get it as scientifically fixed as possible; then the Commission fixes the schedule of rates, that each man must pay.

THE POWER OWNER NOT SACRIFICED.

Senator Bayne.— In other words, the power owner is not sacrificed for the benefit of the lighting concern ?

Commissioner Van Kennen.— No, sir.

Senator Ferris.— It is entirely obvious that if you went to Rochester you would get substantially all the power business; the same is true of Albany, Troy, Syracuse, and Watertown.

Commissioner Van Kennen.— They would have to come down or you would.

Senator Ferris.—That being true, you would, of course, furnish all who applied; there would be no discrimination. Wouldn't it take more than $5,000,000 to furnish all of the cities you have talked of ?

Commissioner Van Kennen.—Yes; I think so.

Senator Ferris.— What would be the total cost, as shown by your figures, of a transmission line across the State from Buffalo to New York and from Watertown to Binghamton; taking the development of 1,500,000 horsepower?

Commissioner Van Kennen.— Take the transmission first. The transmission in the province of Canada, where they are transmitting 300 miles on high voltage wires, carrying 110,000 volts, which is the highest voltage in the world, is 60,000 horsepower capacity. The cost, exclusive of the right of way, is practically $5,000 per mile, so that $5,000,000 would build 1,000 miles of transmission line for 60,000 horsepower. How much it would cost for the development, I can't tell you. I think it is safe enough to say that the development would be approximately upon a basis of something like $10 per horsepower per annum.

Commissioner Moore.— That would include the amortization, interest, up-keep, and maintenance.

Commissioner Van Kennen.— We have places in this State where we can develop water power at $60; in other places it may cost $160. But delivered on the wires, it is fair to assume that it might cost $10 per horsepower.

Senator Ferris.— Your annual yearly charge.

Commissioner Van Kennen.— They deliver power at Toronto which is practically 80 miles from the source, at $18.50 per horsepower, the difference between the $10 and the $18.50 being transmission charges. In different municipalities it would cost a little more; the farther you are away from the source of power, the more it will cost you.

Senator Ferris.— Has your Commission made any figures upon the average distance that the undeveloped powers are from the ultimate consumer? I take it that the great bulk of power is used in New York city.

Commissioner Van Kennen.— It would average in the neighborhood of 250 or 300 miles transmission.

Senator Ferris.— Do you know how much horsepower is used in New York city?

Commissioner Moore.— About 425,000 horsepower, outside of the central stations.

How This Proposition Equalizes Matters.

Commissioner Van Kennen.— How would this affect New York city? Assuming that they are farther away from the St. Lawrence than Watertown, they would have to pay more for their power, but they have the advantage of better freight rates and everything else. In other words, this proposition equalizes matters. If we have to pay more for freights at Watertown than they do at Utica, Watertown being nearer the point of development of power, it would cost them a little less and put them on a basis where they could compete.

Senator Black.— Would you also give power to the various municipalities to take over the plants and transmission systems of the local power companies?

Commissioner Van Kennen.— The scheme is that when a municipality comes to the Commission with an application, we determine the conditions and decide whether we will entertain the application or not. If we entertain the application, we have a hearing of all parties concerned, including the owners of local private plants. After having gone into the facts, and found out what the conditions are, perhaps they may be selling power a great deal cheaper than we can furnish it. If that is so, we deny the application. But assuming that they are not; we go to the private owners and say "For how much will you distribute this power for the municipality? You have all your distribution lines so that you have everything that you need for the distribution." The Commission determines what is fair for distribution charges. After the Commission determines what is fair, that is, the maximum distribution charges, then the matter is submitted to the municipality for their vote upon the question of whether they will take this power and pay these charges. In other words, it makes no difference to the utimate consumer whether the municipality distributes it itself or whether they hire somebody on the field to distribute it, if they do it at the price that the Commission fixes. We have reserved the right to say to a municipality that "you must use this as a distributing line at that price." If they don't, we have the right to deny that municipality the power from this Commission. In other words, we don't want to affect rights and securities of existing plants throughout the State; it is not our purpose to destroy property.

Mr. Baldwin.— What do you do with the power houses?

Commissioner Van Kennen.— They might use them in some other business.

Senator Ferris.— As a matter of fact, the ultimate object of this particular plan is to get cheap power and cheap electricity for the ultimate consumer.

Commissioner Van Kennen.— Yes, sir.

Senator Ferris.— And if it is successful, it means the furnishing to the individual of all the power through the agencies of the political subdivisions, which they may use, throughout the State, by the Conservation Commission?

Commissioner Van Kennen.— Yes, sir. If we can get contracts for all the municipalities, we can furnish every municipality with all the power that it will use.

Senator Black.—Are you certain that the State could use its power of domain in behalf of one of its political divisions?

Commissioner Van Kennen.— I hold that it would be done upon this theory: What are the purposes for which we are taking this property? We are taking it for the public purposes of lighting municipalities, streets, highways, public buildings, commercial lighting, domestic lighting — which is clearly a public function — and for municipal power.

Senator Black.— The city of Rochester, for instance, could not condemn property for a public use which was a public use strictly for the city of Utica. Can the State do the same thing? The appropriating power must use the power for its own public purpose, not for the purposes of another subdivision of the State.

Commissioner Van Kennen.— I don't think there is much in that, because we have public uses. It is a public use. Everybody has a right to use it through the instrumentality of the State, acting through its municipalities.

Senator Bayne.— You say that is a doctrine, but it also really is an object. You won't say openly it is an object; I, myself, think that you ought to take the broad proposition, that this is within the domain. The mere fact that you are benefiting not all the citizens of the State, merely those who are in a position to take advantage of this public benefit, does not exclude it from the power of eminent domain, because that is a public use. If it really only benefited fifty people in the State, provided it was open to everyone in the State to be one of the fifty, it seems to me that is a public use. If there is anything wrong in that proposition, then it seems to me your whole proposition is defective, because some property owner may come in and bring an action and say, "No, the municipality can't do these things." That is a very important part of the scheme; if you want to help people in Northern New York, you ought to help them if you can. If that principle is not sound, it seems to me that your scheme, as well as these other schemes, are all eventually defective. I believe it is sound.

Clearly a Public Use.

Commissioner Van Kennen.— Ninety-six per cent. of the people of the cities of this State are served by their own municipal water supplies with water; 75 per cent. of the cities of this State actually own their own municipal water supply plants. There isn't one of them, I believe, but what sells water for private purposes. The municipal water supply company oftentimes furnishes water for steam engines running elevators, and other purposes that are strictly private. It has always been sustained up to that point.

Take our barge canal; we are doing that for a public purpose, it is a public highway, yet we sell the surplus waters. Nobody has ever disputed that we did not have the right to do that, because the surplus water is an incident to the great public work we have to do. I think it would be sustained. In other words, these public uses unite public health and public safety, although for some reason, I think improperly, public health and public safety have been overworked in this State, and it is done simply because they have tried to get some scheme that would give men power under some other name, and the courts haven't upheld them, and they never will.

Senator Black.— What about the difficulty of interfering with the power companies in this way? They have their municipal franchises; can you parallel their facilities for transmission and do it lawfully? It is a question in my mind whether, where there is a private water supply concern in a city, you can parallel it.

Commissioner Van Kennen.— The municipality certainly can.

Senator Bayne.— In the Schenectady case, the municipality destroyed a private water corporation and the Court of Appeals said they had the power to do it.

Senator Black.— The Court of Appeals at the same time excoriated the municipality.

Senator Bayne.— That depends upon the circumstances. A village water corporation in Staten Island was charging the people about three or four times what the water was worth; they assumed the position that they had the field. The city of New York came in there and said "If you do not reduce your charges and serve better water and do fairly in this business, we will come in and parallel your main."

Mr. Baldwin.— Electric light companies have to get the consent of the Public Service Commission in order to parallel.

Senator Bayne.— The law has been changed. I doubt very much the wisdom of taking away the inherent right of a municipality to furnish its own water supply, except by consent of the Public Service Commission. I think that is now in the law.

THIS PLAN FAIRLY SAFEGUARDS PRIVATE INTERESTS.

Commissioner Van Kennen.— We believe that this scheme fairly safeguards private interests because we have made the provision that through the Commission, which would not be influenced by passion or hatred on account of some corporation charging a little more than they ought to for something, we could fix what the municipality should pay to the private corporation for the distribution of that power. The municipality need not approve that if they don't want to, because it goes to a referendum. If they don't approve it, we have the right to deny them the use of our power.

Senator Loomis.— Does your plan contemplate the removing of flood conditions?

Commissioner Van Kennen.— Our plan approaches this great problem squarely. We shall remove the flood conditions, if at all, by the storage propositions. I have never been very extremely anxious about the flood condition that some people talk about. If there is any menace, then I think that the State having regulated the stream should pay for it. You can't assess on the city of Albany the possible chance that in ten years from now there may be some flood troubles.

Senator Bayne.— You could appropriate a certain amount of State money, provided the city of Albany contributed. That was done with reference to the Albany basin. Repeatedly bills were brought in for the past three-quarters of a century by which the State contributed a certain amount on condition that the city would pay a certain amount.

Commissioner Van Kennen.— Naturally the law overlaps the other law that has been discussed here this afternoon, to a degree. It provides, for instance, for money to be paid by the riparian owner. We have put in the bill the minimum amount that the Commission would be authorized to accept from the riparian owner.

Senator Bayne.— Do you use at all in your scheme this quasi-public intermediate corporation?

Commissioner Van Kennen.— No, sir; direct with the State.

Senator Loomis.— It is your proposition to exclude the idea of having the quasi-public corporation.

Commissioner Van Kennen.— They can go on and make contracts; they are to pay what it is reasonably worth.

Senator Loomis.— It occurred to me that the plans already submitted provide a particular remedy for flood conditions, if these contracts were made by the riparian owners, whereas, under your plan, you would not. They would have a regulation of the flow and prevent these flood conditions.

The Price to be Paid Dwarfs into Insignificance.

Commissioner Van Kennen.— It happens that on the Sacandaga, it would pay to use the power at the foot of the dam, because you can develop over 40,000 horsepower there, 60 per cent. power. You can easily see that the plan we are discussing here involves the development of the undeveloped water power of the State for the purpose of transmitting it to the municipalities of the State, so that the ultimate consumer will get the benefit of it. The question as to whether the riparian owners shall pay three dollars per million feet or whether they shall pay two and a half or two dwarfs into insignificance compared with the general scheme, as I view it.

Senator Bayne.— Is that absolutely fixed in all cases, or is it left to the distinction in individual cases by the Commission?

Commissioner Van Kennen.— We have a minimum limit. The bill you have under consideration, upon many of the things we have discussed this afternoon, foreshadows those in this bill, but we have given the Commission broader powers, even to take electricity. I hold that if we wanted to, under this bill, we could go to a Niagara Falls company and say "We want 50,000 horsepower off your wheels." If they won't give it, take it by condemnation.

We have tried to put in all the powers that we could think of that we might want to use. As I say, we have gone to the length of providing that we could go to Niagara Falls if we wanted 50,000 horsepower and take it from the people that are developing it; of course, we would have to pay for it. I might say in connection with that, the Hydro-Electric Commission buy it at approximately $10 per horsepower. They transmit it 300 miles, at a loss of less than 6 per cent. One thing that was significant to me; for eighteen months they have only been out of service one-half of one minute, which I think is remarkable, but it shows the perfection of their appliances.

Senator Black.— You would have to have a much larger force than you have now.

Commissioner Van Kennen.— We would have to have a larger force, but we have made a provision in the bill for money coming back, so that the State is repaid for every dollar of expense.

I am requested by counsel to call attention to the provision in the bill for preferential uses, if the municipality did not have power enough under contract, or lacked the appropriation, or something of that kind, and could not furnish the desired amount, then preferences would be given as follows:

1. For lighting public streets, highways and buildings.
2. Domestic and commercial lighting.
3. Power for municipal purposes.
4. Power for public service corporations.
5. Power for manufacturing or private use.

CONSTITUTIONAL AMENDMENTS.

One of these concurrent resolutions provides for the use of the Adirondack lands for reservoir purposes. A resolution was passed last year, known as the Burd proposed amendment. I understand that was agreed upon by a large number of civic bodies that are interested in forest protection, bodies which are ultra-conservative, even to the extent of saying that we shall not take down or dead timber out of the Adirondacks,— and by the historical and scenic societies, and many others. They agreed upon an amount not exceeding 3 per cent. of the area of State land for that purpose. It seems to me that unless there is a special reason for it,— and I see no reason from our standpoint,— you should not change that. They have agreed to that and it will not be opposed in that form. The only other thing that ought to go into that resolution by way of amendment would be that not only could you use the land for reservoir purposes, but you ought to have the right to develop the stream from that down, some of it running over State lands as, for instance, by building a power plant at a certain place. That would be helpful to the purposes of this bill. Whether they would oppose that or not, I don't know.

Mr. Baldwin.— That change you refer to was devised with a view of making it as short as possible; the Burd amendment is very long. Every one understands that when you submit an amendment to the Constitution which takes the voter five minutes to read, possibly not to understand, your chances of getting the amendment are very much smaller than they are if you express that in a few brief words. It is simply to give the power to construct storage reservoirs in the Adirondacks and build power lines, and utilize the water. This accomplished nothing less or more and does nothing more than the Burd amendment, which is practically satisfactory so far as the Committee is concerned, if it will only pass.

Commissioner Van Kennen.— I am quite sure that it is more serious than counsel says. I do believe that they will never confirm an unlimited amendment to the Constitution, so that you can take all or any lands in the Adirondacks for storage purposes; at least, I am so advised by the men that have been opposing it.

Senator Bayne.— It is curious that we have not heard from these gentlemen. There isn't a communication from any of them, verbally or in writing, with reference to this matter.

Commissioner Van Kennen.— I have communications that might be valuable to this Committee.

Mr. Baldwin.— They wanted to take it all back when they said they did not understand it. I suppose you refer to the Board of Trade and Transportation report.

Senator Bayne.— The Association for the Protection of the Adirondacks.

Mr. Baldwin.— I have been in conference with the Board of Trade since they issued their statement, and when they understood the bills a little better, they had only two suggestions, both of which Senator Ferris thinks the Committee would be willing to adopt.

Senator Ferris.— They don't change the bill at all, except to make it a little clearer in features that should have been made clearer before.

Commissioner Van Kennen.— I am not opposing this amendment as suggested by Mr. Baldwin at all, although I am not sure whether Mr. Baldwin's amendment would be broad enough for power development. If it is not broad enough, it should be made so. You have got to use transmission lines.

Mr. Baldwin.— That says "for the utilization thereof;" are you going to utilize the water?

Commissioner Van Kennen.— You may utilize it by regulating the flow.

Senator Bayne.— You may utilize it in other respects. A great many people are very jealous of broad powers; it is simply a question of whether it is wise to reject this arrangement.

You might send this on to the next Legislature if you want to; it takes two of them to approve this measure.

Mr. Baldwin.— I thought if the Burd amendment failed of passage, then we would have a shorter amendment accomplishing the same thing which would be ready and you would save two years on the plan by having it ready to submit to the people.

Commissioner Van Kennen.— I want the privilege of filing with this Committee a suggestion with reference to the Burd amendment, for your consideration, so as to provide for power plants and transmission.

Senator Ferris.— While there is a radical difference between the chairman and myself as to some of the theories upon which we base our results, we are not so far apart in the details of our legislation. So that I think that if the Committee agrees with the chairman or with me as to theory, we can probably get together and report a bill under which something can be accomplished.

Commissioner Van Kennen.— The Senator thinks there are more details in this bill than ought to be in there. I think that there is no more in there than should be enacted. We were speaking particularly about the details of the referendum, going to the people, and the plans and specifications that must be made by the Commission, and the schedule of rates that must be fixed by the Commission, so that every person in the municipality will know exactly what he can do, how much it is going to cost him, before there is any vote taken at all; also the municipality must know in the form of the proposed contract between the municipality and the State just the terms of the contract, so that every voter will understand and know just how far the municipality is going to pay for that. Those are details which I think should be left in the bill, because I think you can't do it in any other way and enlighten the people. The Senator says we can put that in ourselves. I would like to have the people read the law when they read that bill. They will understand what they have got to do and I think they will see the advantages of it by reading the law.